



**US Army Corps
of Engineers®**
Engineer Research and
Development Center

ERDC
INNOVATIVE SOLUTIONS
for a safer, better world

Evaluation of 757 Species Under U.S. Endangered Species Act Review on U.S. Department of Defense Lands and their Potential Impact on Army Training

Jinelle H. Sperry, Wade A. Wall, and Matthew G. Hohmann

March 2016



The U.S. Army Engineer Research and Development Center (ERDC) solves the nation's toughest engineering and environmental challenges. ERDC develops innovative solutions in civil and military engineering, geospatial sciences, water resources, and environmental sciences for the Army, the Department of Defense, civilian agencies, and our nation's public good. Find out more at www.erdclibrary.usace.army.mil.

To search for other technical reports published by ERDC, visit the ERDC online library at <http://acwc.sdp.sirsi.net/client/default>.

Evaluation of 757 Species Under U.S. Endangered Species Act Review on U.S. Department of Defense Lands and their Potential Impact on Army Training

Jinelle H. Sperry, Wade A. Wall, and Matthew G. Hohmann

*U.S. Army Engineer Research and Development Center (ERDC)
Construction Engineering Research Laboratory (CERL)
2902 Newmark Dr.
Champaign, IL 61826*

Final Report

Approved for public release; distribution is unlimited.

Prepared for Headquarters, U.S. Army Corps of Engineers
Washington, DC 20314-1000

Abstract

Most land bases where U.S. Army installations reside are ecologically significant and provide refuge for a large number of the nation's threatened and endangered plants and animals. Balancing threatened and endangered species (TES) management with training requirements is an increasingly difficult responsibility as the number of federally listed species grows. This work developed methods for determining impacts of potential future TES listings to Army capabilities and conducted a national level assessment of the risk to Army training by species currently petitioned or under review for federal listing. Of the 757 species reviewed, 233 were found to have the potential to be found on or near Army and Army National Guard installations. Species that were found on a large number of installations, such as the Sprague's pipit (*Anthus spragueii*), are those likely to have the most impact on training. Similarly, installations at greatest risk were those that housed a large number of species. Because of the large number of southeastern U.S. petitioned species, the majority of installations identified as at greatest risk are installations found in that region. Proactive management of these species, including leveraging partner opportunities, has the potential to mitigate negative impacts of Endangered Species Act (ESA) listing.

DISCLAIMER: The contents of this report are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products. All product names and trademarks cited are the property of their respective owners. The findings of this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.
DESTROY THIS REPORT WHEN NO LONGER NEEDED. DO NOT RETURN IT TO THE ORIGINATOR.

Contents

Abstract	ii
Illustrations	iv
Preface	v
1 Introduction	1
1.1 Background	1
1.2 Objectives	2
1.3 Approach	2
1.4 Scope	3
2 Methods	4
2.1 Potential occurrence on installations	4
2.2 Potential habitat on installations	5
2.3 Species' residency	6
2.4 Installation ranks	6
2.5 Probability of listing	6
2.6 Probability of listing analyses	9
2.7 Conservation partnering opportunities	9
2.8 Calculating species and installation impact scores	9
3 Results and Discussion	11
3.1 Potential occurrence on installations	11
3.2 Potential habitat on installations	12
3.2.1 Species' residency	13
3.2.2 Conservation partnering opportunities	13
3.2.3 Installation ranks	13
3.2.4 Probability of listing	13
3.2.5 Calculating Species and Installation Impact Scores	14
4 Conclusions and Recommendations	17
Acronyms and Abbreviations	21
References	22
Appendix A: Species with Potential to Be Found on Active Army and Army National Guard Installations	24
Appendix B: Installation Impact Scores for Active Army and Army National Guard Installations	30
Appendix C: Example Methods and Calculations to Determine the Species Impact Score	34
Appendix D: Species Included in Demonstration of Risk to Military Training Analyses	36
Report Documentation Page (SF 298)	54

Illustrations

Figures

- 1 Number of USFWS petitioned species that may occur on/near active DoD installations, based on county level occurrence data11
- 2 Number of USFWS petitioned species of each taxonomic group that may occur on/near Army and ARNG installations, based on county level occurrence data.....12

Tables

- 1 Number of petitioned species that may occur on/near each installation (top 10 installations are listed), based on county level occurrence data.....12
- 2 Probability of federal listing by taxonomic group. Numbers in parentheses represent number of species included14
- 3 Top 20 species most likely to impact Army training and composite Species Impact Scores based on species' occurrence, life history data, probability of listing and installation importance to Army mission.....15
- 4 Top 20 installations most likely to be impacted by species listing under the ESA and composite Installation Impact Scores based on species' occurrence, life history data, probability of listing, and installation importance to Army mission16
- A-1 Species with potential to be found on active Army and ARNG installations.....24
- B-1 Installation impact scores for active Army and ARNG installations.....30
- C-1 Species Impact Scores for select installations.....35
- D-1 Species included in demonstration of risk to military training analyses36

Preface

This study was conducted for Office of the Assistant Secretary of the Army for Acquisition, Logistics, and Technology, ASA(ALT) under program element 622720A896, “Army Environmental Quality Technology”; Work Unit DD3C7B, “Alternative Threatened and Endangered Species Management Strategies for Emerging Training Regimes.” The technical monitor was Steve Sekscienski, OACSIM-ISE.

This work was conducted by the Ecological Processes Branch (CNN), Installations Division (CN), Construction Engineering Research Laboratory (CERL), Engineer Research and Development Center (ERDC). The CERL principal investigator was Dr. Jinelle H. Sperry. Chris Rewerts was Chief, CEERD-CNN, and Michelle J. Hanson was Chief, CEERD-CN. The associated Technical Director was Alan Anderson, CEERD-CZT. The Deputy Director of ERDC-CERL was Dr. Kirankumar Topudurti and the Director was Dr. Ilker Adiguzel.

CERL is an element of the U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers. COL Bryan S. Green was Commander of ERDC, and Dr. Jeffery P. Holland was the Director.

THIS PAGE INTENTIONALLY LEFT BLANK

1 Introduction

1.1 Background

The Department of Defense (DoD) is responsible for protecting diverse ecosystems on 30 million acres of land in 50 states and nine U.S. territories. Most of the land bases where U.S. Army installations reside are ecologically significant and provide refuge for a large number of the nation's threatened and endangered plants and animals. A recent lawsuit settled by the U.S. Fish and Wildlife Service (USFWS) requires a review of 757 species by 2018 (ESA 1973, Section 4, "Deadline Litigation," case number 2165, U.S. District Court for the District of Columbia). Although many additional listings resulting from this lawsuit could profoundly impact the Army training and testing missions, a detailed assessment of the impact of these species has yet to be undertaken.

Restrictions caused by the need to conserve these threatened and endangered species (TES) and their critical habitat can have a detrimental impact on the military's ability to "train as we fight." As such, the Army recognizes that compliance with the Endangered Species Act (ESA) is the primary environmental encroachment on training and readiness (HQUSACE 2012). In response, the Army has committed itself to ensuring the long-term viability and continuity of training ranges while meeting land stewardship requirements.

Although largely successful in terms of species conservation, managing TES on military lands has proven to be financially and logistically costly. The maintenance of suitable habitat on installations, which are often surrounded by a matrix of unsuitable habitat off installations, has created a situation in which DoD must shoulder the predominant burden of ESA regulations for many species. DoD manages just 3% of federal lands, which shelter more species with federal protective status than any other U.S. agency (Groves et al. 2000; Stein, Scott, and Benton 2008; Flather, Joyce, and Bloomgarden 1994). The Army has identified over 250 threatened, endangered, proposed, and candidate species on or contiguous to its installations. The costs for managing these species have been steadily increasing; it was estimated that the U.S. Army alone spent \$44 million in 2010 on TES management (ACSIM 2010). Balancing TES management with training requirements is a large and increasingly difficult responsibility considering the

large number of federally listed species, which —with the addition of potential new listings— could make the situation even more problematic.

Proactive management and conservation of species proposed for listing could reduce the likelihood of their listing. Recent efforts such as Candidate Conservation Agreements that focus on conservation efforts to avoid listing have proven to be successful for many species. However, funding available for conservation is limited. To optimize the use of these limited funds, the species targeted for conservation efforts should be the species identified as most likely to impact training if listed. The Army has developed strategies and guidance for identifying species at risk on military lands that included a list of species that were considered highest priority.

Although the development of a static species-at-risk list is a valuable first step, the list of species that would be considered high priority is very likely to be dynamic as listing decisions continue to be made and as new species are proposed for listing. This work was undertaken to develop objective methods to determine the potential impact to training by federally listed species, to demonstrate a method of characterizing risk by completing an analysis of risk to training by species currently proposed for listing, and to conduct a national level assessment of the impact of potential TES listings to facilitate the identification of species most likely to impact military training. These methods can be adopted and employed for any installation or command interested in determining the relative impact of any relevant list of at-risk species.

1.2 Objectives

The objectives of this work were to: (1) develop methods for determining impacts of potential future TES listings to Army capabilities, and (2) conduct a national level assessment of the risk to Army training by species currently petitioned or under review for federal listing.

1.3 Approach

The objectives of this work were accomplished in four primary tasks:

1. Methodologies were developed for determining the risk to Army training by at-risk species if listed under ESA.
2. A database was created of species currently petitioned or under review for listing by USFWS, including their likely occurrence on installations, relevant life history characteristics, and installation importance to Army mission.

3. Species were evaluated for their probability of listing based on previous USFWS listing actions.
4. Potential risk to Army training by future TES, based on tasks 1-3, above, was determined.

1.4 Scope

This effort focused primarily on Continental United States (CONUS) Army and Army National Guard (ARNG) installations. Installations in Hawaii and Alaska were included in the initial task in which potential occurrence on installations were identified; however, those installations were removed from subsequent analyses due to lack of availability of habitat data. All species included in the 2011 settled lawsuit between USFWS and Center for Biological Diversity, which required review of 757 petitioned and/or candidate species by 2018, were evaluated.

2 Methods

Criteria for evaluating risk to training, via restricted access to training lands imposed by potential ESA listings of threatened/endangered species, were developed based on expert opinion, factors evaluated by USFWS during ESA listing, and stakeholder input. The six criteria identified as most likely to influence risk to training are:

1. Potential occurrence of species on/near installations
2. Availability and quantity of species preferred habitats on installations
3. Species' residency (e.g., migratory or resident)
4. Installation importance to military mission
5. Potential for species' federal listing under the ESA
6. Potential for conservation partnering opportunities with other public and private land managers.

These six criteria were used to quantify risk to training for the 757 species that the USFWS is required to review by 2018, as part of a settled lawsuit. A list of the species (Appendix A) was obtained from the Center for Biological Diversity.* Appendix D lists the species Included in Demonstration of Risk to Military Training Analyses. Binomial nomenclature was synonymized with NatureServe to facilitate linking data tables in a Microsoft Access database. Information compiled for each species include: common name, scientific name, including any subspecies, varietal, and Distinct Population Segment (DPS) designations. For example, *Sarracenia rubra* var. *wherryi* (common name Wherry's sweet pitcherplant) would include the binomial name in addition to the varietal designation.

2.1 Potential occurrence on installations

County distribution information for all 757 species was obtained from multiple sources. First, information was obtained from NatureServe Explorer,[†] and when available, the USFWS Environmental Online Conservation System (ECOS).[‡] These two sources of information were cross-referenced to identify discrepancies. Next, a thorough literature search was performed for each of the 757 species to identify counties where a species

* <http://www.biologicaldiversity.org/>

† <http://explorer.natureserve.org/>

‡ <http://ecos.fws.gov>

may have been extirpated or identified and not recorded by either Nature-Serve or the USFWS. The county level distribution records for the 757 species were added as a table to the database. A spatial data layer for installations was created by combining several spatial data layers and standardizing installation nomenclature. The county level distribution for the 757 species was cross-referenced with the county level installation occurrence to identify species that occupied the same county as a DoD installation using a designed query in the database. The results represented the first down-selection of species' potential occurrence on installations.

2.2 Potential habitat on installations

For the subset of species that occurred in the same county or counties as a DoD installation, the habitat of terrestrial species was classified according to the 2011 National Land Cover Database (NLCD)* and the habitat of aquatic species according to the National Wetland Inventory (NWI).† Species were classified to the subsystem level under the NWI classification system; this represented the best compromise in terms of habitat specificity.

For each installation, the area occupied by the NWI subsystem categories and the NLCD categories was estimated using the Tabulate_Intersection and Tabulate_Area functions, respectively, in ArcGIS 10.2. Results were exported as comma-separated values files and imported into the database. The estimates were cross-referenced with the habitat classifications for the subset of species using a structured query language (SQL) query in the database to obtain the percentage of an installation representing potential habitat if found on the installation. The estimated area of potential habitat for each species on each installation where it potentially occurs was standardized. A score-range procedure (Malczewski 2000) was applied:

$$x_i = (R_i - R_{\min}) / (R_{\max} - R_{\min}) \quad (2-1)$$

where:

R_i represents the observed values

R_{\min} and R_{\max} are the range of observed values

x_i are the standardized, dimensionless values on a scale of 0 to 1,
with higher values representing greater relevance for assessing
risk or impact to training.

* <http://www.mrlc.gov/nlcd2011.php>

† <http://www.fws.gov/wetlands/>

2.3 Species' residency

Species that are present year-round are likely to have a greater impact on military training than species that are only present seasonally. Consequently, the residency status of the species identified to potentially occur on or near each installation was characterized. Permanent residents were assigned a value of 1, while migratory species were assigned a value of 0.5.

2.4 Installation ranks

This work used the rankings of installations calculated by the Army Integrated Training Area Management Program (ITAM) in 2009. ITAM rankings were calculated based on a variety of factors including training throughput, installation acreage and soil properties. Of the variables included in the rankings, throughput was more heavily weighted (2 times more than other factors). These ranks vary from 1 to 6, with lower values indicating higher relevance for the Army's training and testing missions. Installations that do not have ITAM programs have no assigned rank. The ITAM ranks were transformed such that values had a positive relationship with importance and varied between 1 and 0.1. Under this transformation, ITAM rankings 1-6 equaled 1-0.5 in 0.1 increments, respectively. Installations lacking an ITAM rank were assigned a value of 0.1.

2.5 Probability of listing

Potential listing of any species under the ESA is determined by petition actions, the species' vulnerability (e.g., rarity, population trend), and threats to the species' persistence (e.g., habitat loss or degradation). The USFWS evaluates listing petitions and proposals based on five factors:

1. The present or threatened destruction, modification, or curtailment of a species' habitat or range
2. Overutilization for commercial, recreational, scientific, or educational purposes
3. Disease or predation
4. The inadequacy of existing regulatory mechanisms
5. Other natural or manmade factors affecting a species' continued existence.

USFWS review of these factors includes intensive analyses and public input over a lengthy multi-step process. Consequently, this work used a surrogate approach to estimate probability of listing that used information

about inherent vulnerability and threats to species' persistence contained within available datasets.

NatureServe Explorer provides information about variables that characterize inherent vulnerability and threats to species' persistence in addition to county level distribution data described above (see Section 2.1). NatureServe calls these variables "Conservation Status Factors" and uses them to estimate species' Conservation Status Ranks (e.g., Global, National, and Subnational) (Master et al. 2012). Available data for species* were extracted:

- taxonomy
- rounded global status
- range extent
- area of occupancy
- number of occurrences
- number of occurrences having good viability/integrity
- population size
- environmental specificity
- overall threat impact
- intrinsic vulnerability
- short-term trend
- long-term trend
- migratory status
- number of adult food types
- number of immature food types
- separation distance for unsuitable habitat
- separation distance for suitable habitat.

The inherently quantitative variables (e.g., long- and short-term trend, population size, number of occurrences, population size) are summarized by NatureServe over variably sized bins, which required that they be coded as ordinal data for these analyses. Other variables were either inherently categorical (e.g., migratory status), or ordinal (e.g., environmental sensitivity, threat impact). Species were assigned to one of 12 taxonomic groups (Table 2).

Using county level distribution data available from NatureServe, USFWS ECOS and other sources described above, this work also developed county level quantitative (i.e., continuous) estimates of species' extant ranges and estimates of the percent of their ranges from which they have been extirpated. This estimate of species' range extent was pursued due to the amount of missing data for this NatureServe variable and the somewhat undesirable characteristics of the NatureServe binning process.

Because data for overall threat impact were missing for approximately 60% of species within the NatureServe database and the importance of

* Master et al. (2012) includes detailed descriptions of these variables.

current and emerging threats to ESA listing decisions, this work sought to develop an alternate estimate of threat impact. Given that the first of the five factors (i.e., habitat modification or destruction) evaluated by the USFWS is the most commonly cited in determinations that lead to federal listing (Wilcove et al. 1998), species' county level distribution data were used in combination with the NLCD to develop quantitative (i.e., continuous) estimates of range-wide habitat loss and degradation. Similar to the process described above for "Potential Habitat on Installations," the area of each of the 16 NLCD categories across species' county level ranges was extracted and the percent represented by developed (i.e., developed open space, developed low intensity, developed medium intensity, and developed high intensity), and cultivated crop cover types was calculated. This estimate was also extended to include the NLCD pasture/hay category. Because the 2011 NLCD does not include Hawaii or Alaska, these two alternate estimates of threat impact are not available for species occurring on or near installations in those states.

Additionally, a categorical predictor variable was developed that summarizes species' taxonomic uniqueness by coding whether they represented a monotypic genus, species, or subspecies/population. Data for this variable were extracted from online resources such as the USDA NRCS PLANTS Database,* Wikipedia, and IUCN Redlist.

To explore the influence of conservation agreements on listing probability, data were extracted from the USFWS ECOS on the existence of Candidate Conservation Agreements, Candidate Conservation Agreements with Assurances, and/or Action Plans for each species. Note that information about this predictor variable was likely incomplete for species that have not yet undergone a listing determination.

Finally, the USFWS ECOS was used to develop a response variable summarizing listing determinations (i.e., threatened, endangered, not warranted) that have already been made for a subset of the 757 proposed species from 2011-2015. Because some poorly represented taxonomic groups (e.g., turtles) had small sample sizes, all of the steps described above were applied to an additional 40 species for which listing determinations had been made as far back as 1987, depending on the group.

* <http://plants.usda.gov/java/>

2.6 Probability of listing analyses

The assembled dataset was analyzed in an attempt to identify the variables that might be useful for predicting the likelihood that species are ultimately listed under ESA by first performing univariate tests and then performing model selection with all the variables. An initial univariate Pearson's chi-squared test (Pearson 1900) was performed on the categorical variables and univariate logistic regression (McCullough and Nelder 1989) on the continuous variables using a binominal distribution and a logit link. Variables identified from the chi-squared tests and logistic regressions with significant or marginally significant p-values were included in the full generalized linear model. Model selection of nested models was performed using Akaike Information Criterion (AIC) values (Akaike 1973).

2.7 Conservation partnering opportunities

Protected areas surrounding DoD installations represent partnering opportunities for the conservation of species. A lack of potential partnering opportunities suggests that installations will likely have greater conservation responsibility for species occurring on their lands, which will increase the impact on their training mission if proposed species are listed. The area of land within an 80.5 km radius of an installation that contained tracts representing partnering opportunities using the Protected Areas Data Portal* was estimated. An 80.5 km buffer was created around each installation using the buffer tool in ArcGIS 10.2. The intersection between the resulting buffer and the protected areas data layer was estimated using the Tabulate_Intersection function. The areas of partner lands identified for installations by this process were transformed by dividing each value by the maximum estimated area. The resulting dimensionless, transformed values for this criterion ranged from 1 (largest amount of potential partnering lands) to 0.001 (least amount of potential partnering lands).

2.8 Calculating species and installation impact scores

To identify the relative risk that each species potentially poses to Army training and testing, Species Impact Scores were calculated as the sum of the estimated impacts for each installation where the species' potentially occurs. Species impacts on installation training were calculated by multiplying

* <http://gapanalysis.usgs.gov/padus/>

the values of the potential habitat, species' residency, installation rank, conservation partnering opportunities and probability of listing criteria. Expressed as an equation, the Species Impact Score takes the following form:

$$\sum_{i=1}^n (\text{habitat on installation } i) * (\text{species' residency } i) * (\text{installation rank } i) * (\text{conservation partnering opportunities } i) * (\text{probability of listing } i) \quad (2-2)$$

where n is the number of installations where the species has the potential to occur.

To identify the relative risk to which installations would potentially be exposed by multiple species, Installation Impact Scores were calculated by summing the products described above, for the different species occurring on or near each installation.

Transformations applied to the various criteria described above ensured that Species and Installation Impact Scores were not unduly influenced by the disparate values of the different criteria. Species and Installation Impact Scores should be interpreted in a relative, rather than an absolute context.

Two separate analyses were also completed: one that included conservation partner opportunities within Species and Installation Impact Scores, and one that did not. The analyses excluding partner opportunities provide an examination of current risk to training, whereas the inclusion of partner opportunities incorporates potential mitigation through regional conservation partnering.

3 Results and Discussion

3.1 Potential occurrence on installations

Of the 757 species under review for federal listing, 233 may occur on/near active Army or ARNG installations, based on county level occurrence data (Figure 1). For those species occurring on Army and ARNG installations, plants were the most represented taxa (87 species), followed by invertebrates (77 species) and then vertebrate taxa (Figure 2).

The number of species per installation varied from one (numerous installations) to a maximum of 52 (Schofield Barracks, HI; Table 1). Numerous species had wide ranging distributions and so had the potential to occur on a large number of installations. The number of installations per species varied from one (numerous species) to a maximum of 91 by *Myotis septentrionalis* (northern long-eared bat).

Figure 1. Number of USFWS petitioned species that may occur on/near active DoD installations, based on county level occurrence data.

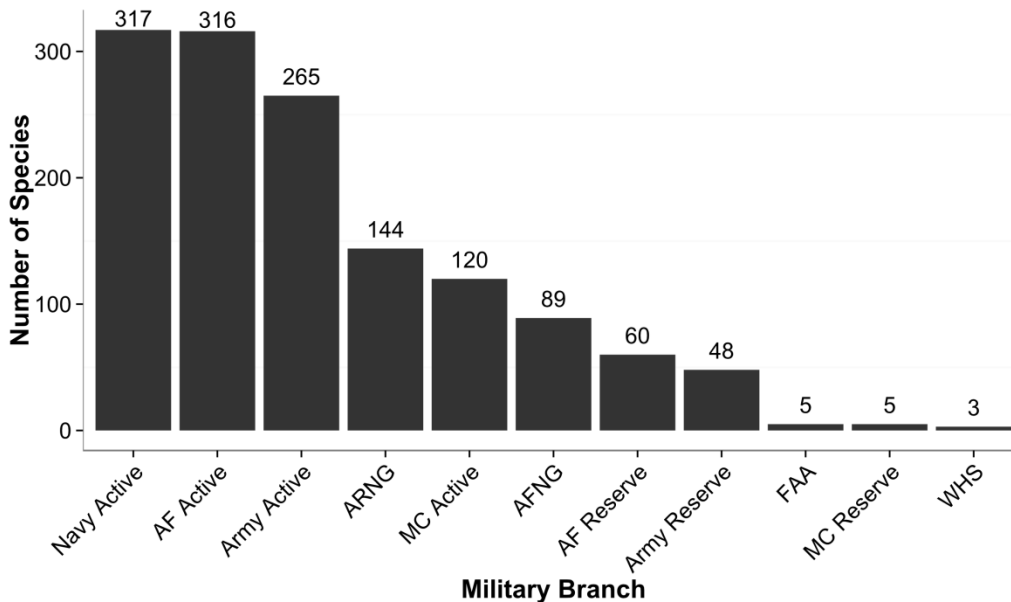


Figure 2. Number of USFWS petitioned species of each taxonomic group that may occur on/near Army and ARNG installations, based on county level occurrence data.

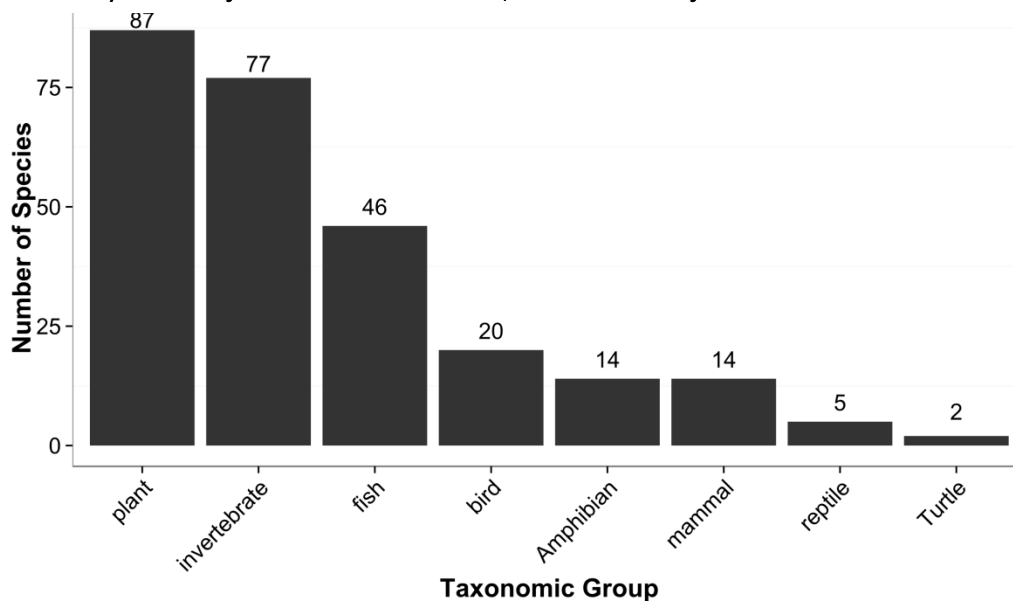


Table 1. Number of petitioned species that may occur on/near each installation (top 10 installations are listed), based on county level occurrence data.

Installation	Number of Species
Schofield Barracks, HI	52
Fort Benning, GA	35
Hickam AFB, HI	33
Fort Shafter, HI	33
Redstone Arsenal, AL	24
Fort Rucker, AL	23
Fort Bragg, NC	20
Camp Shelby, MS	18
Fort Knox, KY	18
Military Ocean Terminal Sunny Point, NC	18

3.2 Potential habitat on installations

For CONUS Army and ARNG installations, of the 144 installations that had the potential to house petitioned species based on county level distributions (above), the amount of species-specific preferred habitat on the installation ranged from 0% of the installation (numerous) to 86.1% of the installation (*Calopogon oklahomensis* on Camp Gruber), with an average of 7.94% of the installation. Of the 841 species-installations pairs for which habitat data were available, a large number (616; 73%) had less than 5% of the installation with species-specific habitats. This would indicate that many species/installations are relatively low risk for impacts on Army training.

3.2.1 Species' residency

Given that the majority of the species potentially occurring on or near installations were plants and invertebrates, most species were permanent residents. However five temperate and three neotropical migrant birds were also represented, including Sprague's pipit (*Anthus spragueii*), red knot (*Calidris canutus rufa*), Bicknell's thrush (*Catharus bicknelli*), yellow-billed cuckoo (*Coccyzus americanus occidentalis*), gull-billed tern (*Gelochelidon nilotica vanrossemi*), black rail (*Laterallus jamaicensis jamaicensis*), ashy storm petrel (*Oceanodroma homochroa*), and Xantus's murrelet (*Synthliboramphus hypoleucus*).

3.2.2 Conservation partnering opportunities

For all 144 CONUS Army and ARNG installations included in analyses, other federal lands (e.g., U.S. Forest Service and National Park Service) represented the largest percentage of nearby (<80.5 km buffer) potential partner land (mean = 10.18%; range = 0–84%). State lands were also highly represented (mean = 5.51%; range = 0–71%). All other land owner types, including municipal, private, regional agency and Native American holdings all comprised less than 2% of the buffer areas, respectively. Fort Wainwright, AK, had the largest percentage of buffer area comprised of protected lands (19.38%), followed by Hawthorne Army Depot, NV (15.10%) and Elmendorf Air Force Base, AK (14.11%). Many installations had less than 1% of buffer lands comprised of partner lands. This includes installations with heavy training loads such as Fort Hood, TX (0.26%), Fort Riley, KS (0.46%) and Fort Bragg, NC (0.84%).

3.2.3 Installation ranks

Of the 856 species-installations pairs examined (which includes Hawaii), 27 were on Category 1 ITAM ranked installations, 98 were on Category 2 installations, 135 were on Category 3 installations, 137 were on Category 4 installations, 64 were on Category 5 installations, 43 were on Category 6 installations, and 351 were on unranked installations.

3.2.4 Probability of listing

Two of the univariate categorical variables had significant p-values: taxonomic group ($\chi^2_{8df} = 17.3$; $P = 0.027$) and whether a conservation agreement was in place ($\chi^2_{1df} = 7.8$; $P = 0.005$). The taxonomic group to which a species belonged was a significant predictor of whether a species would be

listed under the ESA. For example, mollusks were listed 82% of the time, while vascular plants were only listed 63% of the time (Table 3). If a conservation agreement was in place, species were listed 53% of the time; the absence of a conservation agreement increased the probability of being listed to 80%. The percentage of developed land was the single continuous variable that was correlated with the listing status ($P = 0.02$), with the probability of being listed increasing as the percentage of developed land increased.

Table 2. Probability of federal listing by taxonomic group. Numbers in parentheses represent number of species included.

Taxonomic Group	Probability of Listing
Amphibian (12)	0.83
Arthropod (24)	0.29
Birds (18)	0.72
Fish (14)	0.64
Mammal (20)	0.65
Mollusk (17)	0.82
Plants (35)	0.63
Reptile (10)	0.60
Turtle (7)	1.00

Model selection for the generalized linear model that included both categorical and continuous variables indicated that the model with the best fit (i.e., lowest AIC) included the variables identified above: taxonomic group, conservation agreement in place, and the percentage of developed land in the range of the species. This model had a residual deviance of 108.1 on 108 degrees of freedom (versus the null model deviance of 143.1). However, for prediction purposes it is difficult to obtain conservation agreement information for all of the 757 species. Therefore the predictive model did not include conservation agreement, but did include an interaction term between taxonomic group and the percentage of developed land. The resulting model had a residual deviance of 104.4 on 103 degrees of freedom. This predictive model was used to estimate probability of listing for the 757 list of species. Species for which a listing decision was made prior to these analyses were assigned a probability of one.

3.2.5 Calculating Species and Installation Impact Scores

Calculating Species and Installation Impact Scores with and without conservation partnering opportunities, this work identified the 20 species and installations most likely to impact or be impacted by training restrictions

(Table 3). Appendix A includes the full list of species and associated impact scores. Although the lists here represent those with the highest potential impact scores, other factors, such as species-specific microhabitat requirements (e.g., seeps for seepage salamander and snowpack for North American wolverine), are not reflected here.

The species with the greatest potential for impact is the Sprague's pipit (*Anthus spragueii*), which has the potential to be located on 43 installations, including high priority installations such as Fort Hood, Fort Bliss and Fort Polk. Some of these installations, such as Fort Hood and Fort Still, have extensive areas of available habitat (35 and 74% respectively). Other species with high impact scores include the greater sage grouse (*Centrocercus urophasianus*) found on 10 installations with an average of 23% of the installations available habitats and seepage salamander (*Desmognathus aeneus*), which may be found on four installations including Fort Benning.

Installations with the highest potential for impact are Fort Benning with 32 potential species, White Sands Missile Range with 11 potential species and Fort Stewart with 15 potential species. Appendix B lists the full list of installations and associated impact scores.

When opportunities for conservation partnerships (i.e., quantity of nearby protected lands) were included, the results are similar, with a few notable exceptions. Fort Irwin would replace Camp Shelby on the list of highest priority installations, based on the large number of partnership opportunities near Fort Irwin. Similarly, the species *Gulo gulo luscus* (North American wolverine) and *Xerospermophilus mohavensis* (Mohave ground squirrel) would be considered high priority because of the large quantity of potential partner lands in the western states where these species reside.

Table 3. Top 20 species most likely to impact Army training and composite Species Impact Scores based on species' occurrence, life history data, probability of listing and installation importance to Army mission.

Species	Common Name	Species Impact Score
<i>Anthus spragueii</i>	Sprague's Pipit	0.95
<i>Centrocercus urophasianus</i>	Greater Sage Grouse	0.85
<i>Desmognathus aeneus</i>	Seepage Salamander	0.75
<i>Cynomys gunnisoni</i>	Gunnison Prairie Dog	0.62
<i>Lobelia boykinii</i>	Boykin's Lobelia	0.59
<i>Carex impressinervia</i>	Ravine Sedge	0.53
<i>Macbridea caroliniana</i>	Carolina Bogmint	0.52

Species	Common Name	Species Impact Score
<i>Centrocercus minimus</i>	Gunnison Sage Grouse	0.49
<i>Balduina atropurpurea</i>	Purple Honeycomb Head	0.38
<i>Lindera subcoriacea</i>	Bog Spicebush	0.31
<i>Amorpha georgiana georgiana</i>	Georgia Lead Bush	0.30
<i>Myotis septentrionalis</i>	Northern Long-Eared Bat	0.22
<i>Pituophis ruthveni</i>	Louisiana Pine Snake	0.21
<i>Ambystoma barbouri</i>	Streamside Salamander	0.19
<i>Pituophis melanoleucus lodingi</i>	Black Pine Snake	0.19
<i>Notophthalmus perstriatus</i>	Striped Newt	0.18
<i>Lesquerella globosa</i>	Globe Bladderpod	0.17
<i>Gulo luscus</i>	North American Wolverine	0.16
<i>Sistrurus catenatus</i>	Massasauga Rattlesnake	0.15
<i>Sideroxylon thornei</i>	Swamp Buckthorn	0.15

Table 4. Top 20 installations most likely to be impacted by species listing under the ESA and composite Installation Impact Scores based on species' occurrence, life history data, probability of listing, and installation importance to Army mission.

Installation	Installation Impact Score
Fort Benning, GA	2.29
White Sands Missile Range, NM	1.47
Fort Stewart, GA	1.33
Fort Lewis, WA	0.73
Fort Bragg, NC	0.69
Camp Shelby, MS	0.53
Fort Bliss, TX	0.50
Fort Carson, CO	0.42
Fort Polk, LA	0.25
Fort Rucker, AL	0.25
Camp Blanding	0.22
Orchard Range Training Site (TS) Boise, ID	0.21
Fort Knox, KY	0.19
Fort Campbell, KY/TN	0.19
Fort Chaffee, AR	0.18
Fort Sill, OK	0.15
Fort Irwin, CA	0.13
Aberdeen Proving Ground, MD	0.11
Dugway Proving Ground, UT	0.11
Fort Hood, TX	0.09

4 Conclusions and Recommendations

Military installations and ranges are a significant platform for achieving the readiness of U.S. military forces. These assets are used for training and testing purposes to rigorously expose troops to all of the realistic threats and tactics of war. It is critical for effective planning and resource management to evaluate and consider the potential risk to training by ESA mandates. This work demonstrated a method for assessing potential risk to training from ESA listings at the national scale. This method was applied to the current list of 757 petitioned species and it was found that, although many of these species have the potential to be found on installations, the majority of species are not likely to have significant impact. However, a smaller number of species have the potential to be significantly important, both in terms of the number of installations and the percentage area of those installations impacted.

As the USFWS makes listing decisions and new species are petitioned, the list of species under review changes rapidly. This includes high profile decisions such as the September 2015 decision not to list the greater sage grouse.* Because of this dynamic situation, it was decided to demonstrate these methods on a static list, i.e., the list of 757 species included in the 12 July 2011 legal settlement with USFWS. Although listing decisions were made during the course of these analyses, all species were retained throughout. The specific identities of the species and installations categorized as high risk may change based on current information, but these results are likely representative of general patterns of risk. Further, this work included only CONUS installations for most of the analyses due to lack of recent habitat data for OCONUS sites. In particular, even though Hawaii had a large number of petitioned species, Hawaii installations were not included in these analyses because the most recent NLCD update for Hawaii was in 2001.

The petitioned species most likely to impact Army training are those that span large geographic ranges that encompass numerous installations. This list includes:

- Sprague's Pipit (potential to be located on 43 installations)
- Greater Sage Grouse (potential to be located on 10 installations)
- Seepage Salamander (potential to be located on four installations).

* <http://www.fws.gov/greatersagegrouse/findings.php>

Because an Army importance ranking was included for each installation, those species with ranges that included installations critical to the Army mission were ranked higher. The highest ranked species included representatives from a wide variety of taxa including birds, amphibians, mammals and plants. Currently, Army decisions related to TES management occur at the installation or perhaps regional scale. These results suggest that a more enterprise wide approach, with input and cooperation from all affected installations, would be advantageous for species that span multiple installations and regions.

In addition to evaluating risk to training by individual species, risk to each Army installation was also evaluated. The list of installations most likely to be impacted by species listing under the ESA include:

- Fort Benning, GA (32 potential species)
- White Sands Missile Range, NM (11 potential species)
- Fort Stewart, GA (15 potential species).

Due to the high number of petitioned species from the southeastern U.S., many of highest ranked installations were in this region. This includes Fort Benning, GA, Fort Stewart, GA, Fort Bragg, NC, Camp Shelby, MS, Fort Polk, LA, and Fort Rucker, AL. Many of the species likely to be found on these installations were invertebrates and plants that are associated with riparian/aquatic habitats. Given the importance of many of the southeastern installations for the Army mission, a large number of newly listed species could have important implications for Army readiness.

This demonstration used data that were readily available and accessible. County level species occurrence data is available from a variety of sources including NatureServe Explorer (natureserve.org/explorer), Plants Database (plants.usda.gov), and taxa-specific occurrence databases (e.g., eBird). Similarly, the habitat and protected area databases used are publicly available and free to download. Several issues with the available data for certain species were encountered, including changes in species taxonomy/nomenclature and insufficient range information (e.g., numerous invertebrate species). For these species, these analyses relied on additional data sources such as primary scientific literature. For species of particular interest, it would be recommended that more detailed occurrence data either be solicited or otherwise acquired.

The results of this work's probability of listing analysis highlight the importance of regional influences and regional partnerships. It was found that the most important predictors of USFWS listing were taxonomic group, proportion of developed land within the species range, and participation in conservation agreements. In combination, the latter two variables suggest that, although reductions in species habitats increase the likelihood of listing, regional conservation partnerships can mitigate that risk. This can be particularly important for the Army given the rapid increase in encroachment around military lands. While management is not necessarily incompatible with training (Benton, Ripley, and Powledge 2008; Beaty et al. 2003; Leslie et al. 1996), it is still limited to the lands under the jurisdiction of the installation. Furthermore, the benefits of land management may already be realized with little opportunity for improvement in habitat quality or size (e.g., Beaty et al. 2003). Through strategic partnering, the Army may be able to proactively address management of species at risk, both within and outside the fence line, thereby decreasing the probability of USFWS listing.

Because of the importance of regional partnering, the quantity of available partner lands were included in these analyses of petitioned species risk to training. Several regional initiatives have recently been implemented for listed and petitioned species, some of which that include Army partners. Examples include the USDA Regional Conservation Partner Program, the Southeast Regional Partnership for Planning and Sustainability (SERPAS),^{*} Sentinel Landscapes,[†] and the Sage Grouse Initiative.[‡] Further development and Army engagement in these efforts, particularly for those species or regions with the highest risk of impact, has the potential to confer substantial benefits to the Army including decreased probability of listing of petitioned species. These analyses did not include the Army Compatible Use Buffer (ACUB) or DoD Readiness and Environmental Protection Integration (REPI) programs, both of which provide partnering opportunities, through conservation easements, on areas not currently designated as protected. These programs have and continue to be very instrumental in building partnering opportunities and expanding conservation lands around installations.

^{*} <http://serppas.org>

[†] <http://www.sentinellandscapes.org/>

[‡] <http://www.sagegrouseinitiative.com/>

This work evaluated risk to training at the national scale; however, a more fine-scale analyses could be done at the level of a single installation or region. Many installations have detailed information on species occurrences on the site as well as information on training frequency, intensity and timing (e.g., the Range Facility Management Support System [RFMSS]). In combination, this data could be used to provide a detailed analysis of the specific areas and times of potential conflict between at-risk species and military training.

Acronyms and Abbreviations

Term	Definition
AIC	Akaiki Information Criterion
ANG	Air National Guard
ARNG	Army National Guard
CEERD	U.S. Army Corps of Engineers, Engineer Research and Development Center
CERL	Construction Engineering Research Laboratory
CONUS	Continental United States
DoD	Department of Defense
DPS	Distinct Population Segment
EPA	Environmental Protection Agency
ERDC	Engineer Research and Development Center
ESA	Endangered Species Act
GAP	National Gap Analysis Program
INRMP	Integrated Natural Resources Management Plans
ITAM	Integrated Training Area Management
IUCN	International Union for Conservation of Nature and Natural Resources
MTA	Military Training Area
MRLC	Multi-Resolution Land Characteristics Consortium
NLCD	National Land Cover Data
NRCS	Natural Resources Conservation Service
NWI	National Wetland Inventory
OACSIM	Office of the Assistant Chief of Staff for Installation Management
OCONUS	Outside Continental United States
OMB	Office of Management and Budget
OSD	Office of the Secretary of Defense
PA	<u>P</u> otential to be found on <u>A</u> ctive (Army and ARNG installations)
RFMSS	Range Facility Management Support System
ROC	Receiver Operating Characteristic
SERPAS	Southeast Regional Partnership for Planning and Sustainability
SF	Standard Form
SQL	Structured Query Language
TES	Threatened and Endangered Species
TR	Technical Report
TS	Training Site
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
UTM	Universal Transverse Mercator
WWW	World Wide Web

References

- Akaike, H. 1973. Information theory and an extension of the maximum likelihood principle. *Proceedings of the Second International Symposium on Information Theory*. B. N. Petrov and F. Csaki (eds.) Budapest: Akademiai Kiado, pp 267-281.
- Assistant Chief of Staff for Installation Management (ACSIM). 2010. Army Threatened and Endangered Species Report 2010.
- Beaty, T. A., A. E. Bivings, T. G. Reid, T. L. Myers, S. D. Parris, R. Costa, T. J. Hayden, T. E. Ayers, S. M. Farley, and W. E. Wooden. 2003. Success of the Army's 1996 Red-cockaded Woodpecker management guidelines. *Federal Facilities Environmental Journal* 14:43-53.
- Benton, N., D. Ripley, and F. Powledge. 2008. *Conserving Biodiversity on Military Lands: A Guide for Natural Resources Managers*. Arlington, VA: NatureServe.
- Center for Biological Diversity. Undated. Web site, <http://www.biologicaldiversity.org/>
- Flather, C. H., L. A. Joyce, and C. A. Bloomgarden. 1994. *Species Endangerment Patterns in the United States*. General Technical Report RM-241. Fort Collins, CO: U.S. Department of Agriculture (USDA) Forest Service.
- Groves, C. R., L. S. Kutner, D. M. Stoms, L. P. Murray, J. M. Scott, M. Schafale, A. S. Weakley, and R. L. Pressey. 2000. Owning up to our responsibilities: Who owns lands important for biodiversity? *Precious Heritage: The Status of Biodiversity in the United States*. New York, NY: Oxford University Press, pp 275-300.
- Headquarters, U.S. Army Corps of Engineers (HQUSACE). 2012. U.S. Army Environmental Requirements and Technology Assessments (AERTA). Army Environmental Quality Technology Program (EQT). Washington, DC: HQUSACE, Office of the Assistant Chief of Staff for Installation Management (OACSIM).
- Leslie, M., G. K. Meffe, J. L. Hardesty, and D. L. Adams. 1996. *Conserving Biodiversity on Military Lands: A Handbook for Natural Resource Managers*. Arlington, VA: NatureServe.
- Malczewski, J. 2000. On the use of weighted linear combination method in GIS: Common and best practice approaches. *Transactions in GIS* 4(1):5-22.
- Master, L. L., D. Faber-Langendoen, R. Bittman, G.A. Hammerson, B. Heide, L. Ramsay, K. Snow, A. Teucher, and A. Tomaino. 2012. *NatureServe Conservation Status Assessments: Factors for Evaluating Species and Ecosystem Risk*. Arlington, VA: NatureServe.
- NatureServe. 2015. *NatureServe Explorer: An Online Encyclopedia of Life*. Web site, <http://explorer.natureserve.org/>
- McCullough, P. and J. A. Nelder. 1989. *Generalized Linear Models*. London: Chapman and Hall.

Multi-Resolution Land Characteristics Consortium (MRLC). 2015. *National Land Cover Database 2011 (NLCD 2011)*. Web page, <http://www.mrlc.gov/nlcd2011.php>

Natureserve. 2015. *A Network Connecting Science with Conservation*. Web site, www.Natureserve.org

Pearson, K. 1900. Mathematical contribution to the theory of evolution VII: On the correlation of characters not quantitatively measurable. *Philosophical Transactions of the Royal Society of London*. 195A:1-47

Sage Grouse Initiative. 2015. *Sage Grouse Initiative: Wildlife conservation through Sustainable Ranching*. Web site, <http://www.sagegrouseinitiative.com/>

Southeast Regional Partnership for Planning and Sustainability (SERPPAS). 2015. SERPPAS. Web site, <http://serppas.org>

Stein, B. A., C. Scott, and N. Benton. 2008. Federal lands and endangered species: The role of military and other federal lands in sustaining biodiversity. *Bioscience* 58(4):339-347.

U.S. Department of Agriculture (USDA). 2015. Plants database. *National Resource Conservation Center*. Web page, <http://plants.usda.gov/java/>

U.S. Department of Agriculture (USDA). 2015. *2015 Endangered Species Act Finding*. Web site, <http://www.fws.gov/greatersagegrouse/findings.php>

U.S. Endangered Species Act (ESA). 1973. Title 16 United States Code (USC), Sections 1531 – 1544. <http://www.fws.gov/laws/lawsdigest/esact.html>

U.S. Fish and Wildlife Service (USFWS). Undated. *ECOS Environmental Conservation Online System*. Web site, <http://ecos.fws.gov>

———. 2015. *National Wetlands Inventory*. Web site, <http://www.fws.gov/wetlands/>

U.S. Geological Survey (USGS). 2014. *National Gap Analysis Program (GAP) | Protected Areas Data Portal*. Web site, <http://gapanalysis.usgs.gov/padus/>

Wilcove, D. S., D. Rothstein, J. Dubow, A. Phillips, and E. Losos. 1998. Quantifying threats to imperiled species in the United States. *Bioscience* 48(8): 607-615.

Appendix A: Species with Potential to Be Found on Active Army and Army National Guard Installations

Species with potential to be found on active Army and ARNG installations, based on county level occurrence data, and calculated Species Impact Scores. Species Impact Scores were calculated both without consideration for partnering opportunities (Without PO) and with (With PO). Table A-1 lists all species that were included in a 2011 legal settlement between USFWS and Center for Biological Diversity, which required a review of species for ESA listing by 2018.

Table A-1. Species with potential to be found on active Army and ARNG installations.

Latin Name	Species Impact Scores	
	Without PO	With PO
<i>Anthus spragueii</i>	0.95	0.66
<i>Centrocercus urophasianus</i>	0.85	0.45
<i>Desmognathus aeneus</i>	0.75	0.08
<i>Cynomys gunnisoni</i>	0.62	0.25
<i>Lobelia boykinii</i>	0.59	0.03
<i>Carex impressinervia</i>	0.53	0.05
<i>Macbridea caroliniana</i>	0.52	0.05
<i>Centrocercus minimus</i>	0.49	0.36
<i>Balduina atropurpurea</i>	0.38	0.01
<i>Lindera subcoriacea</i>	0.31	0.01
<i>Amorpha georgiana georgiana</i>	0.30	0.01
<i>Myotis septentrionalis</i>	0.22	0.02
<i>Pituophis ruthveni</i>	0.21	0.02
<i>Ambystoma barbouri</i>	0.19	0.00
<i>Pituophis melanoleucus lodingi</i>	0.19	0.01
<i>Notophthalmus perstriatus</i>	0.18	0.01
<i>Lesquerella globosa</i>	0.17	0.00
<i>Gulo gulo luscus</i>	0.16	0.07
<i>Sistrurus catenatus catenatus</i>	0.15	0.01
<i>Sideroxylon thornei</i>	0.15	0.01
<i>Illicium parviflorum</i>	0.14	0.00
<i>Baptisia megacarpa</i>	0.14	0.02
<i>Eupatorium paludicola</i>	0.14	0.00
<i>Xerospermophilus mohavensis</i>	0.13	0.05
<i>Myotis leibii</i>	0.12	0.01

Latin Name	Species Impact Scores	
	Without PO	With PO
<i>Amblyscirtes linda</i>	0.11	0.01
<i>Schoenoplectus hallii</i>	0.11	0.00
<i>Calopogon oklahomensis</i>	0.11	0.01
<i>Arabis georgiana</i>	0.09	0.01
<i>Castanea pumila ozarkensis</i>	0.09	0.01
<i>Eremophila alpestris strigata</i>	0.09	0.03
<i>Euphydryas editha taylori</i>	0.08	0.03
<i>Thomomys mazama glacialis</i>	0.08	0.03
<i>Thomomys mazama pugetensis</i>	0.08	0.03
<i>Thomomys mazama tumuli</i>	0.08	0.03
<i>Thomomys mazama yelmensis</i>	0.08	0.03
<i>Centrocerus urophasianus Columbia Basin</i>	0.08	0.03
<i>Rhynchospora thornei</i>	0.08	0.01
<i>Polites mardon</i>	0.07	0.02
<i>Clonophis kirtlandii</i>	0.06	0.00
<i>Rhynchospora crinipes</i>	0.06	0.00
<i>Procambarus fitzpatricki</i>	0.06	0.00
<i>Symphyotrichum georgianum</i>	0.05	0.01
<i>Ophiogomphus incurvatus</i>	0.05	0.00
<i>Percina bimaculata</i>	0.05	0.00
<i>Graptemys gibbonsi</i>	0.05	0.00
<i>Linum westii</i>	0.04	0.00
<i>Hartwrightia floridana</i>	0.04	0.00
<i>Graptopetalum bartramii</i>	0.04	0.01
<i>Rhexia parviflora</i>	0.03	0.00
<i>Rhexia salicifolia</i>	0.03	0.00
<i>Toxolasma pullus</i>	0.03	0.00
<i>Croton elliotii</i>	0.03	0.00
<i>Isoetes hyemalis</i>	0.03	0.00
<i>Nuphar lutea sagittifolia</i>	0.03	0.00
<i>Laterallus jamaicensis jamaicensis</i>	0.03	0.00
<i>Erigeron lemmonii</i>	0.03	0.01
<i>Elassoma boehlkei</i>	0.03	0.00
<i>Graptemys barbouri</i>	0.03	0.00
<i>Elliptio arcata</i>	0.02	0.00
<i>Elliptio arca</i>	0.02	0.00
<i>Synthliboramphus hypoleucus</i>	0.02	0.00
<i>Eurycea chamberlaini</i>	0.02	0.00
<i>Anodontoides radiatus</i>	0.02	0.00
<i>Oceanodroma homochroa</i>	0.02	0.00
<i>Hamiota australis</i>	0.02	0.00
<i>Villosa choctawensis</i>	0.02	0.00

Latin Name	Species Impact Scores	
	Without PO	With PO
<i>Ammodrammus maritimus macgillivraii</i>	0.02	0.00
<i>Marshallia grandiflora</i>	0.02	0.00
<i>Glaucidium ridgwayi cactorum</i>	0.01	0.00
<i>Cordulegaster sayi</i>	0.01	0.00
<i>Ptilimnium ahlesii</i>	0.01	0.00
<i>Hesperia dacotae</i>	0.01	0.00
<i>Ludwigia ravenii</i>	0.01	0.00
<i>Ludwigia brevipes</i>	0.01	0.00
<i>Scutellaria ocmulgee</i>	0.01	0.00
<i>Sylvilagus transitionalis</i>	0.01	0.00
<i>Fimbristylis perpusilla</i>	0.01	0.00
<i>Pectis imberbis</i>	0.01	0.00
<i>Procambarus pictus</i>	0.01	0.00
<i>Libellula jesseana</i>	0.01	0.00
<i>Coccyzus americanus occidentalis</i>	0.01	0.01
<i>Najas filifolia</i>	0.01	0.00
<i>Zapus hudsonius luteus</i>	0.01	0.00
<i>Fusconaia masoni</i>	0.00	0.00
<i>Moxostoma robustum</i>	0.00	0.00
<i>Amphiuma pholeter</i>	0.00	0.00
<i>Gomphus septima</i>	0.00	0.00
<i>Alasmidonta varicosa</i>	0.00	0.00
<i>Crystallaria asprella</i>	0.00	0.00
<i>Plethobasus cyphus</i>	0.00	0.00
<i>Helianthus occidentalis plantagineus</i>	0.00	0.00
<i>Etheostoma tippecanoe</i>	0.00	0.00
<i>Elassoma alabamae</i>	0.00	0.00
<i>Epioblasma triquetra</i>	0.00	0.00
<i>Noturus furiosus</i>	0.00	0.00
<i>Fusconaia subrotunda</i>	0.00	0.00
<i>Cicindela marginipennis</i>	0.00	0.00
<i>Cumberlandia monodonta</i>	0.00	0.00
<i>Notropis ariommus</i>	0.00	0.00
<i>Waldsteinia lobata</i>	0.00	0.00
<i>Pyganodon gibbosa</i>	0.00	0.00
<i>Lasmigona subviridis</i>	0.00	0.00
<i>Simpsonia ambigua</i>	0.00	0.00
<i>Quadrula cylindrica cylindrica</i>	0.00	0.00
<i>Percina macrocephala</i>	0.00	0.00
<i>Cyprinella callitaenia</i>	0.00	0.00
<i>Etheostoma maculatum</i>	0.00	0.00
<i>Platanthera integrilabia</i>	0.00	0.00

Latin Name	Species Impact Scores	
	Without PO	With PO
<i>Procambarus lylei</i>	0.00	0.00
<i>Elliptio lanceolata</i>	0.00	0.00
<i>Elliptio fraterna</i>	0.00	0.00
<i>Orconectes virginienensis</i>	0.00	0.00
<i>Fusconaia burkei</i>	0.00	0.00
<i>Pleurobema strodeanum</i>	0.00	0.00
<i>Ptychobranchus jonesi</i>	0.00	0.00
<i>Villosa fabalis</i>	0.00	0.00
<i>Notropis buccula</i>	0.00	0.00
<i>Notropis oxyrhynchus</i>	0.00	0.00
<i>Villosa ortmanni</i>	0.00	0.00
<i>Lagopus leucura altipetens</i>	0.00	0.00
<i>Elliptio spinosa</i>	0.00	0.00
<i>Alasmidonta arcua</i>	0.00	0.00
<i>Elliptio purpurella</i>	0.00	0.00
<i>Alasmidonta triangulata</i>	0.00	0.00
<i>Anodonta heardi</i>	0.00	0.00
<i>Etheostoma cragini</i>	0.00	0.00
<i>Megalagrion leptodemas</i>	0.00	0.00
<i>Megalagrion nigrohamatum nigrolineatum</i>	0.00	0.00
<i>Megalagrion oceanicum</i>	0.00	0.00
<i>Narthecium americanum</i>	0.00	0.00
<i>Dichanthelium hirstii</i>	0.00	0.00
<i>Pteronotropis euryzonus</i>	0.00	0.00
<i>Percina nasuta</i>	0.00	0.00
<i>Pleurobema rubrum</i>	0.00	0.00
<i>Pyrgulopsis thompsoni</i>	0.00	0.00
<i>Orconectes blacki</i>	0.00	0.00
<i>Pleurobema dolabellodes</i>	0.00	0.00
<i>Etheostoma cinereum</i>	0.00	0.00
<i>Hibiscus dasycalyx</i>	0.00	0.00
<i>Ptychobranchus subtentum</i>	0.00	0.00
<i>Catharus bicknelli</i>	0.00	0.00
<i>Rana pretiosa</i>	0.00	0.00
<i>Cryptobranchus alleganiensis alleganiensis</i>	0.00	0.00
<i>Toxolasma lividus</i>	0.00	0.00
<i>Lagopus leucura rainierensis</i>	0.00	0.00
<i>Fallicambarus burrisi</i>	0.00	0.00
<i>Notropis perpallidus</i>	0.00	0.00
<i>Cambarus fasciatus</i>	0.00	0.00
<i>Etheostoma brevirostrum</i>	0.00	0.00
<i>Etheostoma microlepidum</i>	0.00	0.00

Latin Name	Species Impact Scores	
	Without PO	With PO
<i>Trillium texanum</i>	0.00	0.00
<i>Etheostoma trisella</i>	0.00	0.00
<i>Cambarus speciosus</i>	0.00	0.00
<i>Potamogeton tennesseensis</i>	0.00	0.00
<i>Percina kusha</i>	0.00	0.00
<i>Gelochelidon nilotica vanrossemi</i>	0.00	0.00
<i>Calidris canutus rufa</i>	0.00	0.00
<i>Etheostoma tecumsehi</i>	0.00	0.00
<i>Percina crypta</i>	0.00	0.00
<i>Cambarus coosawattae</i>	0.00	0.00
<i>Noturus munitus</i>	0.00	0.00
<i>Percina cymatotaenia</i>	0.00	0.00
<i>Pleurobema oviforme</i>	0.00	0.00
<i>Etheostoma tuscumbia</i>	0.00	0.00
<i>Orconectes maletae</i>	0.00	0.00
<i>Amphinemura mockfordi</i>	0.00	0.00
<i>Erimystax harrisi</i>	0.00	0.00
<i>Obovaria unicolor</i>	0.00	0.00
<i>Cryptobranchus alleganiensis bishopi</i>	0.00	0.00
<i>Centrocercus urophasianus Bi-State</i>	0.00	0.00
<i>Notropis ozarcanus</i>	0.00	0.00
<i>Noturus lachneri</i>	0.00	0.00
<i>Necturus lewisi</i>	0.00	0.00
<i>Cambarus jonesi</i>	0.00	0.00
<i>Arborimus longicaudus North Oregon Coast</i>	0.00	0.00
<i>Stylurus potulentus</i>	0.00	0.00
<i>Cambarellus diminutus</i>	0.00	0.00
<i>Notropis suttkusi</i>	0.00	0.00
<i>Caecidotea cannula</i>	0.00	0.00
<i>Problema bulenta</i>	0.00	0.00
<i>Lampsilis rafinesqueana</i>	0.00	0.00
<i>Pteronotropis hubbsi</i>	0.00	0.00
<i>Leuctra szczytkoi</i>	0.00	0.00
<i>Cambarellus lesliei</i>	0.00	0.00
<i>Physostegia correllii</i>	0.00	0.00
<i>Pseudemys rubriventris</i>	0.00	0.00
<i>Percina aurora</i>	0.00	0.00
<i>Obovaria subrotunda</i>	0.00	0.00
<i>Noturus gladiator</i>	0.00	0.00
<i>Pyrgulopsis chupaderae</i>	0.00	0.00
<i>Oncorhynchus clarki virginalis</i>	0.00	0.00
<i>Iotichthys phlegethontis</i>	0.00	0.00

Latin Name	Species Impact Scores	
	Without PO	With PO
<i>Noturus gilberti</i>	0.00	0.00
<i>Etheostoma osburni</i>	0.00	0.00
<i>Planorbella magnifica</i>	0.00	0.00
<i>Gomphus consanguis</i>	0.00	0.00
<i>Noturus crypticus</i>	0.00	0.00
<i>Io fluviatilis</i>	0.00	0.00
<i>Allocapnia brooksi</i>	0.00	0.00
<i>Percina williamsi</i>	0.00	0.00
<i>Villosa nebulosa</i>	0.00	0.00
<i>Fallicambarus gilpini</i>	0.00	0.00
<i>Gila nigra</i>	0.00	0.00
<i>Medionidus conradicus</i>	0.00	0.00
<i>Percina brevicauda</i>	0.00	0.00
<i>Fundulus julisia</i>	0.00	0.00
<i>Fusconaia barnesiana</i>	0.00	0.00
<i>Pyrgulopsis bernardina</i>	0.00	0.00
<i>Orconectes sheltae</i>	0.00	0.00
<i>Fallicambarus hortonii</i>	0.00	0.00
<i>Potentilla basaltica</i>	0.00	0.00
<i>Noturus fasciatus</i>	0.00	0.00
<i>Gila robusta</i>	0.00	0.00
<i>Vetericaris chaceorum</i>	0.00	0.00
<i>Deirochelys reticularia miaria</i>	0.00	0.00
<i>Procaris hawaiana</i>	0.00	0.00
<i>Stygobromus kenki</i>	0.00	0.00
<i>Cyprinella xaenura</i>	0.00	0.00
<i>Chrosomus saylora</i>	0.00	0.00
<i>Cambarus extraneus</i>	0.00	0.00
<i>Stygobromus indentatus</i>	0.00	0.00
<i>Palaemonella burnsi</i>	0.00	0.00
<i>Pleurocera pyrenella</i>	0.00	0.00
<i>Oecetis parva</i>	0.00	0.00
<i>Canis lupus baileyi</i>	0.00	0.00
<i>Etheostoma forbesi</i>	0.00	0.00
<i>Etheostoma striatulum</i>	0.00	0.00
<i>Lasmigona holstonia</i>	0.00	0.00
<i>Lithasia duttoniana</i>	0.00	0.00
<i>Megaceros aenigmaticus</i>	0.00	0.00
<i>Spermophilus washingtoni</i>	0.00	0.00
<i>Thamnophis eques</i>	0.00	0.00

Appendix B: Installation Impact Scores for Active Army and Army National Guard Installations

Table B-1 lists Installation Impact Scores for active Army and ARNG installations that have the potential to house petitioned/candidate species, based on county level occurrence data. Impact scores are based on the sum of Species Impact Scores for those species with potential to occur on each installation. Impact scores were calculated both without consideration for partnering opportunities (Without PO) and with (With PO). All species were included in a 2011 legal settlement between USFWS and Center for Biological Diversity, which required a review of species for ESA listing by 2018.

Table B-1. Installation impact scores for active Army and ARNG installations.

Installation Name	Installation Impact Score	
	Without PO	With PO
Fort Benning	2.29	0.26
White Sands Missile Range	1.47	1.07
Fort Stewart	1.33	0.04
Fort Lewis	0.73	0.25
Fort Bragg	0.69	0.01
MTA Camp Shelby	0.53	0.02
Fort Bliss	0.50	0.50
Fort Carson	0.42	0.09
Fort Polk	0.25	0.02
Fort Rucker	0.25	0.03
MTC Camp Blanding	0.22	0.02
Orchard Range TS Boise	0.21	0.05
Fort Knox	0.19	0.00
Fort Campbell	0.19	0.00
Fort Chaffee MTC	0.18	0.02
Fort Sill	0.15	0.00
National Training Center And Fort Irwin	0.13	0.05
Aberdeen Proving Ground	0.11	0.01
Dugway Proving Ground	0.11	0.04
Fort Hood	0.09	0.00
MTCH Camp Grayling	0.08	0.01
Fort Dix	0.08	0.01
Fort Huachuca	0.08	0.02
Fort Gordon	0.07	0.00

Installation Name	Installation Impact Score	
	Without PO	With PO
Fort Jackson	0.07	0.00
Camp Joseph T Robinson	0.07	0.00
MTCH Camp Guernsey	0.06	0.00
Camp Gruber	0.06	0.00
Camp Atterbury	0.06	0.00
Fort McCoy	0.04	0.00
MTCH Camp Roberts	0.04	0.00
MTA Camp Edwards	0.02	0.00
Fort A P Hill	0.02	0.00
Fort McClellan ARNG Training Center	0.02	0.00
Yuma Proving Ground	0.01	0.01
Ng Beauregard Training Range	0.01	0.00
Fort Pickett, ARNG MTC	0.01	0.00
Camp Grafton	0.01	0.00
Camp Dodge Johnston TS	0.01	0.00
Camp Minden TS	0.01	0.00
NG TS Ethan Allen Range	0.01	0.00
Fort Drum	0.01	0.00
NG MTA Limestone Hills	0.01	0.00
McAlester Army Ammunition Plant	0.01	0.00
Fort Eustis	0.01	0.00
Military Ocean Terminal Sunny Point	0.01	0.00
Redstone Arsenal	0.01	0.00
MTA-L Camp Williams	0.01	0.00
Tooele Army Depot	0.01	0.00
Ravenna Training And Log Site	0.01	0.00
Fort Leonard Wood	0.00	0.00
MTA Fort William Henry Harrison	0.00	0.00
Hawthorne Army Depot	0.00	0.00
Blue Grass Army Depot	0.00	0.00
MTA Camp Crowder Neosho	0.00	0.00
Schofield Barracks	0.00	0.00
Camp Swift	0.00	0.00
Warren Grove Range	0.00	0.00
Iowa Army Ammunition Plant	0.00	0.00
CTC Fort Custer Training Center	0.00	0.00
West Point Military Reservation	0.00	0.00
CTA Camp McCain	0.00	0.00
Camp Bowie	0.00	0.00
Fort Indiantown Gap	0.00	0.00
Longhorn Army Ammunition Plant	0.00	0.00
NG Greenlief TS/UTES 01	0.00	0.00

Installation Name	Installation Impact Score	
	Without PO	With PO
Anniston Army Depot	0.00	0.00
Deseret Chemical Depot	0.00	0.00
Fort Riley	0.00	0.00
ITC Camp San Luis Obispo	0.00	0.00
Fort Wolters	0.00	0.00
MTA Camp Rilea	0.00	0.00
VTS Tullahoma	0.00	0.00
Camp Maxey	0.00	0.00
VTS Catoosa	0.00	0.00
CTC Camp Dawson-Kingwood	0.00	0.00
Pine Bluff Arsenal	0.00	0.00
Caswell Training Site	0.00	0.00
Marseilles (MTA Training Area)	0.00	0.00
Holston Army Ammunition Plant	0.00	0.00
Rock Island Arsenal	0.00	0.00
Radford Army Ammunition Plant	0.00	0.00
McEntire Joint NGB	0.00	0.00
Newport Chemical Depot	0.00	0.00
Letterkenny Army Depot	0.00	0.00
Smoky Hill Air National Guard (ANG) Range	0.00	0.00
Camp Villere	0.00	0.00
Fort Lee	0.00	0.00
Camp Dawson Ta	0.00	0.00
Camp Clark	0.00	0.00
Fort Sam Houston	0.00	0.00
Picatinny Arsenal	0.00	0.00
Kansas Army Ammunition Plant	0.00	0.00
Us Army Research Laboratory Adelphi	0.00	0.00
Stones Ranch Military Reservation	0.00	0.00
Fort Belvoir	0.00	0.00
Ng Mead TS/FMS 06/Utes 02	0.00	0.00
Fort George G Meade	0.00	0.00
Camp Ashland	0.00	0.00
Defense Distribution Depot Susquehanna	0.00	0.00
Fort Shafter	0.00	0.00
Hickam AFB	0.00	0.00
Fort McPherson	0.00	0.00
Milan Army Ammunition Plant	0.00	0.00
Lone Star Army Ammunition Plant	0.00	0.00
Briery Mountain Ta	0.00	0.00
Goldmine TA	0.00	0.00
Pringle TA	0.00	0.00

Installation Name	Installation Impact Score	
	Without PO	With PO
Whitehair TA	0.00	0.00
Red River Army Depot	0.00	0.00
Sierra Army Depot	0.00	0.00
Camp Perry TS (CTC)	0.00	0.00
Camp Ripley	0.00	0.00
Lake City Army Ammunition Plant	0.00	0.00
Detroit Arsenal	0.00	0.00
Mississippi Army Ammunition Plant	0.00	0.00
Tobyhanna Army Depot	0.00	0.00
Fort Detrick	0.00	0.00
Sunflower Army Ammunition Plant	0.00	0.00
Pueblo Chemical Depot	0.00	0.00
Wappapello	0.00	0.00
Joint System Manufacturing Center Lima	0.00	0.00
Fort Monroe	0.00	0.00
Fort Leavenworth	0.00	0.00
U.S. Army Soldier Systems Center Natick	0.00	0.00
Presidio Of Monterey	0.00	0.00
Florence Readiness Center	0.00	0.00
Fort Myer	0.00	0.00
Fort Monmouth	0.00	0.00
Defense Supply Center Richmond	0.00	0.00
Fort Ord	0.00	0.00
Camp Rapid	0.00	0.00
Carlisle Barracks	0.00	0.00
Defense Distr Depot San Joaquin	0.00	0.00
Defense Supply Center Columbus	0.00	0.00
Florence-Darlington Tech Col	0.00	0.00
Fort Hamilton	0.00	0.00
Ng Camp Fogarty TS	0.00	0.00
Riverbank AAP	0.00	0.00
Scranton Army Ammunition Plant	0.00	0.00
Stewart IAP	0.00	0.00
Umatilla Chemical Depot	0.00	0.00
Walter Reed Army Medical Center	0.00	0.00
Watervliet Arsenal	0.00	0.00

Appendix C: Example Methods and Calculations to Determine the Species Impact Score

Example methods and calculations to determine the Species Impact Score without consideration of partnering opportunities for a petitioned species, (Bog Spicebush, *Lindera subcoriacea*) follow:

1. Identify relevant life history and county level data. Data can be accessed from a variety of sources including scientific literature, herbaria, taxonomic specific field guides or web-based databases such as NatureServe Explorer.* NatureServe indicates Bog Spicebush is a resident species with extant occurrences in the following counties:
 - a. Baldwin, Clarke, Escambia, and Mobile (Alabama)
 - b. Escambia and Okaloosa, Florida; Burke, Hancock and Jones, Georgia; Washington (Louisiana)
 - c. Forrest, George, Harrison, Jackson, Pearl River, Perry, and Stone (Mississippi)
 - d. Chatham, Cumberland, Hoke, Johnston, Lee, Montgomery, Moore, Richmond, Robeson, Scotland, and Wake (North Carolina)
 - e. Aiken, Barnwell, Lexington, and Richland (South Carolina).
2. Determine which active Army and ARNG installations the species may occur on based on county level overlap. The following installations occur in the counties where Bog Spicebush may occur, based on number 1 above: Camp Shelby, Fort Bragg, Fort Gordon, Fort Jackson and McEntire Joint NGB.
3. Determine how much of the species habitat is found on each installation. Habitat data is available via the National Land Cover Dataset for terrestrial species and National Wetland Inventory for aquatic species. Area of preferred habitat on the installation can be derived using a merge function in a spatial analyses program (e.g., ESRI ArcMap). In the case of Bog Spicebush, which inhabits permanently moist to wet, shrub-dominated seepage wetlands, the area of each installation representing potential Bog Spicebush habitat is as follows: Camp Shelby (39307 ha), Fort Bragg (38,475 ha), Fort Gordon (88970 ha), Fort Jackson (8835 ha) and McEntire Joint NGB (190 ha).
4. Determined probability of listing based on the estimated logistic regression or values listed in Table C-1. In the case of Bog Spicebush,

* www.Natureserve.org

a plant, the logistic regression estimated a 0.56 probability of listing, while taxonomic-based probability of listing is slightly higher (0.63).

5. Installation importance to Army can be calculated based on installation available data (e.g., throughput via RFMSS) or by ITAM scores. In the case of Bog Spicebush, the installations with potential occurrence have the following ITAM and standardized ITAM scores: Camp Shelby (3/0.8), Fort Bragg (2/0.9), Fort Gordon (4/0.7), Fort Jackson (4/0.7) and McEntire Joint NGB (NA/0.1).
6. Resident species receive a score of 1 for resident/migratory status and migratory species receive a score of 0.5. In the case of Bog Spicebush, a score of 1 is included.
7. Based on the information above, the following Species Impact Scores were calculated as:

$$\sum_{i=1}^n (\text{habitat on installation } i) * (\text{species' residency } i) * (\text{installation rank } i) * (\text{probability of listing } i) \quad (\text{C-1})$$

Table C-1. Species Impact Scores for select installations

Installation	Standardized Habitat Availability	Species Residency	Standardized Installation Rank	Probability of Listing	Installation-Specific Bog Spicebush Impact Score
Camp Shelby	0.276	1	0.8	0.56	0.124
Fort Bragg	0.270	1	0.9	0.56	0.136
Fort Gordon	0.063	1	0.7	0.56	0.025
Fort Jackson	0.062	1	0.7	0.56	0.024
McEntire Joint NGB	0.001	1	0.1	0.56	0.000
Composite Bog Spicebush Impact Score =					0.308

Appendix D: Species Included in Demonstration of Risk to Military Training Analyses

Table D-1 lists all species that were included in a 2011 legal settlement between USFWS and Center for Biological Diversity, which required a review of species for ESA listing by 2018.

Table D-1. Species included in demonstration of risk to military training analyses.

Latin Name	Common Name	Taxon
<i>Abronia alpina</i>	Ramshaw Meadows Abronia	plant
<i>Acroneuria kosztarabi</i>	Virginia Stone	invertebrate
<i>Aeschynomene pratensis</i>	Meadow Joint-vetch	plant
<i>Agarodes logani</i>	Logan's Agarodes Caddisfly	invertebrate
<i>Agave eggersiana</i>	Agave eggersiana	plant
<i>Alasmidonta arcua</i>	Altamaha Arcmussel	invertebrate
<i>Alasmidonta triangulata</i>	Southern Elktoe	invertebrate
<i>Alasmidonta varicosa</i>	Brook Floater	invertebrate
<i>Allocapnia brooksi</i>	Sevier Snowfly	invertebrate
<i>Allocapnia cunninghami</i>	Karst Snowfly	invertebrate
<i>Allocapnia fumosa</i>	Smokies Snowfly	invertebrate
<i>Alnus maritima</i>	Seaside Alder	plant
<i>Amblyopsis spelaea</i>	Northern Cavefish	fish
<i>Amblyscirtes linda</i>	Linda's Roadside-Skipper	invertebrate
<i>Ambrysus funebris</i>	Nevares Spring Naucorid Bug	invertebrate
<i>Ambystoma barbouri</i>	Streamside Salamander	Amphibian
<i>Ammodrammus maritimus macgillivrayi</i>	MacGillivray's seaside sparrow	bird
<i>Amorpha georgiana</i>	Georgia Leadplant	plant
<i>Amphinemura mockfordi</i>	Tennessee Forestfly	invertebrate
<i>Amphiuma pholeter</i>	One-toed Amphiuma	Amphibian
<i>Anaea troglodyta floridalis</i>	Florida Leafwing	invertebrate
<i>Anaxyrus canorus</i>	Yosemite toad	Amphibian
<i>Anodonta heardi</i>	Apalachicola Floater	invertebrate
<i>Anodontoides radiatus</i>	Rayed Creekshell	invertebrate
<i>Anthus spragueii</i>	Sprague's Pipit	bird
<i>Antrorbis breweri</i>	Manitou Cavesnail	invertebrate
<i>Aphaostracon asthenes</i>	Blue Spring Hydrobe Snail	invertebrate
<i>Aphaostracon chalarogyrus</i>	Freemouth Hydrobe Snail	invertebrate
<i>Aphaostracon monas</i>	Wekiwa Hydrobe Snail	invertebrate
<i>Aphaostracon pycnus</i>	Dense Hydrobe Snail	invertebrate
<i>Aphaostracon theiocrenetum</i>	Clifton Spring Hydrobe Snail	invertebrate
<i>Arabis georgiana</i>	Georgia rockcress	plant

Latin Name	Common Name	Taxon
<i>Arborimus longicaudus</i> North Oregon Coast	Red tree vole (North Oregon Coast DPS)	mammal
<i>Argythamnia blodgettii</i>	Blodgett's Wild Mercury	plant
<i>Arnoglossum diversifolium</i>	Variable-leaf Indian-plantain	plant
<i>Artemisia campestris wormskioldii</i>	Northern Wormwood	plant
<i>Astragalus anserinus</i>	Goose Creek Milkvetch	plant
<i>Astragalus cusickii packardiae</i>	Packard's Milkvetch	plant
<i>Astragalus tortipes</i>	Sleeping Ute Milkvetch	plant
<i>Atlantea tulita</i>	Puerto Rican harlequin butterfly	invertebrate
<i>Automeris louisiana</i>	Louisiana Eyed Silkmoth	invertebrate
<i>Balduina atropurpurea</i>	Purple Balduina	plant
<i>Baptisia megacarpa</i>	Apalachicola Wild Indigo	plant
<i>Bartonia texana</i>	Texas Screwstem	plant
<i>Batrachoseps stebbinsi</i>	Tehachapi slender salamander	Amphibian
<i>Bidens amplexans</i>	Ko'oko'olau	plant
<i>Bidens campylotheca pentamera</i>	Ko'oko'olau	plant
<i>Bidens campylotheca waihoiensis</i>	Ko'oko'olau	plant
<i>Bidens conjuncta</i>	Ko'oko'olau	plant
<i>Bidens micrantha ctenophylla</i>	Grassland beggarticks	plant
<i>Bison bison bison</i>	Wild Plains bison	mammal
<i>Blarina carolinensis shermani</i>	Sherman's Short-tailed Shrew	mammal
<i>Boltonia montana</i>	Doll's-daisy	plant
<i>Bouchardina robisoni</i>	Bayou Bodcau Crayfish	invertebrate
<i>Brachyramphus brevirostris</i>	Kittlitz's murrelet	bird
<i>Brickellia mosieri</i>	Florida brickell bush	plant
<i>Caecidotea cannula</i>	Cannulate Cave Isopod	invertebrate
<i>Calamagrostis expansa</i>	Maui Reedgrass	plant
<i>Calamagrostis hillebrandii</i>	Hillebrand's Small-reedgrass	plant
<i>Calamovilfa arcuata</i>	Rivergrass	plant
<i>Calidris canutus rufa</i>	Red Knot ssp. rufa	bird
<i>Calochortus persistens</i>	Siskiyou Mariposa Lily	plant
<i>Calopogon oklahomensis</i>	Oklahoma Grass-pink	plant
<i>Cambarellus blacki</i>	Cypress Crayfish	invertebrate
<i>Cambarellus diminutus</i>	Least Crayfish	invertebrate
<i>Cambarellus lesliei</i>	Angular Dwarf Crayfish	invertebrate
<i>Cambarus bouchardi</i>	Big South Fork Crayfish	invertebrate
<i>Cambarus catagius</i>	Greensboro Burrowing Crayfish	invertebrate
<i>Cambarus chasmodactylus</i>	New River Crayfish	invertebrate
<i>Cambarus chaugaensis</i>	Chauga Crayfish	invertebrate
<i>Cambarus coosawattae</i>	Coosawattae Crayfish	invertebrate
<i>Cambarus cracens</i>	Slenderclaw Crayfish	invertebrate
<i>Cambarus cryptodytes</i>	Dougherty Plain Cave Crayfish	invertebrate
<i>Cambarus cymatilis</i>	Conasauga Blue Burrower	invertebrate
<i>Cambarus eeseehensis</i>	Grandfather Mountain Crayfish	invertebrate

Latin Name	Common Name	Taxon
<i>Cambarus elkensis</i>	Elk River Crayfish	invertebrate
<i>Cambarus extraneus</i>	Chickamauga Crayfish	invertebrate
<i>Cambarus fasciatus</i>	Etowah Crayfish	invertebrate
<i>Cambarus georgiae</i>	Little Tennessee Crayfish	invertebrate
<i>Cambarus harti</i>	Piedmont Blue Burrower	invertebrate
<i>Cambarus jezerinaci</i>	Spiny Scale Crayfish	invertebrate
<i>Cambarus jonesi</i>	Alabama Cave Crayfish	invertebrate
<i>Cambarus nerterius</i>	Greenbrier Cave Crayfish	invertebrate
<i>Cambarus obeyensis</i>	Obey Crayfish	invertebrate
<i>Cambarus parrishi</i>	Hiwassee Headwater Crayfish	invertebrate
<i>Cambarus pristinus</i>	Pristine Crayfish	invertebrate
<i>Cambarus scotti</i>	Chattooga River Crayfish	invertebrate
<i>Cambarus speciosus</i>	Beautiful Crayfish	invertebrate
<i>Cambarus spicatus</i>	Broad River Spiney Crayfish	invertebrate
<i>Cambarus strigosus</i>	Lean Crayfish	invertebrate
<i>Cambarus unestami</i>	Blackbarred Crayfish	invertebrate
<i>Cambarus veteranus</i>	Big Sandy Crayfish	invertebrate
<i>Cambarus williami</i>	Brawleys Fork Crayfish	invertebrate
<i>Canavalia pubescens</i>	Lava-field Jack-bean	plant
<i>Canis lupus baileyi</i>	Mexican gray wolf	mammal
<i>Carex brysonii</i>	Bryson's Sedge	plant
<i>Carex impressinervia</i>	Impressed-nerved Sedge	plant
<i>Castanea pumila ozarkensis</i>	Ozark Chinquapin	plant
<i>Castilleja christii</i>	Christ's Indian-paintbrush	plant
<i>Catharus bicknelli</i>	Bicknell's thrush	bird
<i>Catostomus discobolus jarrovi</i>	Zuni Bluehead Sucker	fish
<i>Centrocercus minimus</i>	Gunnison sage grouse	bird
<i>Centrocercus urophasianus</i>	Greater sage grouse	bird
<i>Centrocercus urophasianus Bi-State</i>	Western sage grouse (Mono Basin/Bi-State DPS)	bird
<i>Centrocercus urophasianus Columbia Basin</i>	Western sage grouse (Columbia Basin DPS)	bird
<i>Chamaecrista lineata keyensis</i>	Big Pine Partridge Pea	plant
<i>Chamaesyce deltoidea pinetorum</i>	Pineland Broomspurge	plant
<i>Chamaesyce deltoidea serpyllum</i>	Wedge Spurge	plant
<i>Chionactis occipitalis klauberi</i>	Tucson Shovelnose Snake	reptile
<i>Chorizanthe parryi fernandina</i>	San Fernando Valley Chorizanthe	plant
<i>Christella boydiae</i>	Christella boydiae	plant
<i>Chromolaena frustrata</i>	Cape Sable thoroughwort	plant
<i>Chrosomus saylori</i>	Laurel Dace	fish
<i>Cicindela albissima</i>	Coral Pink Dunes tiger beetle	invertebrate
<i>Cicindela highlandensis</i>	Highlands Tiger Beetle	invertebrate
<i>Cicindela marginipennis</i>	Cobblestone Tiger Beetle	invertebrate
<i>Circurina wartoni</i>	Warton cave meshweaver	invertebrate
<i>Clonophis kirtlandii</i>	Kirtland's Snake	reptile

Latin Name	Common Name	Taxon
<i>Coccyzus americanus occidentalis</i>	Western yellow-billed cuckoo	bird
<i>Cochliopa texana</i>	Phantom Cave Snail	invertebrate
<i>Colligyrus n. sp. 2</i>	Masked Duskysnail	invertebrate
<i>Cordia rupicola</i>	Puerto Rico manjack	plant
<i>Cordulegaster sayi</i>	Say's Spiketail	invertebrate
<i>Coreopsis integrifolia</i>	Ciliate-leaf Tickseed	plant
<i>Cottus specus</i>	Grotto sculpin	fish
<i>Crangonyx grandimanus</i>	Florida Cave Amphipod	invertebrate
<i>Crangonyx hobbsi</i>	Hobb's Cave Amphipod	invertebrate
<i>Croton elliotii</i>	Elliott's Croton	plant
<i>Cryptobranchus alleganiensis alleganiensis</i>	Eastern Hellbender	Amphibian
<i>Cryptobranchus alleganiensis bishopi</i>	Ozark hellbender	Amphibian
<i>Cryptomastix devia</i>	Puget Oregonian	invertebrate
<i>Cryptomastix hendersoni</i>	Columbia Oregonian	invertebrate
<i>Crystallaria asprella</i>	Crystal Darter	fish
<i>Crystallaria cincotta</i>	Diamond Darter	fish
<i>Cumberlandia monodonta</i>	Spectaclecase	invertebrate
<i>Cyanea asplenifolia</i>	Haha	plant
<i>Cyanea calycina</i>	Oahu Cyanea	plant
<i>Cyanea kunthiana</i>	Kunth's Cyanea	plant
<i>Cyanea lanceolata</i>	Lanceleaf Cyanea	plant
<i>Cyanea obtusa</i>	Blunt-lobe Cyanea	plant
<i>Cyanea tritomantha</i>	'Oha	plant
<i>Cyclargus thomasi bethunebakeri</i>	Miami blue butterfly	invertebrate
<i>Cynomys gunnisoni</i>	Gunnison's Prairie Dog	mammal
<i>Cyprinella callitaenia</i>	Bluestripe Shiner	fish
<i>Cyprinella xaenura</i>	Altamaha Shiner	fish
<i>Cyprogenia aberti</i>	Western Fanshell	invertebrate
<i>Cyrtandra filipes</i>	Slender-stalked Cyrtandra	plant
<i>Cyrtandra kaulantha</i>	Ha'iwale	plant
<i>Cyrtandra oxybapha</i>	Pohakea Gulch Cyrtandra	plant
<i>Cyrtandra sessilis</i>	Windy-ridge Cyrtandra	plant
<i>Dalea carthagenensis floridana</i>	Florida Prairie-clover	plant
<i>Deirochelys reticularia miaria</i>	Western Chicken Turtle	Amphibian
<i>Dendroica angelae</i>	Elfin woods warbler	bird
<i>Deroceras hesperium</i>	Evening Fieldslug	invertebrate
<i>Desmognathus abditus</i>	Cumberland Dusky Salamander	Amphibian
<i>Desmognathus aeneus</i>	Seepage Salamander	Amphibian
<i>Dexteria floridana</i>	Florida Fairy Shrimp	invertebrate
<i>Dichanthelium hirstii</i>	Hirsts' Panicgrass	plant
<i>Digitaria pauciflora</i>	Two-spike Crabgrass	plant
<i>Dinacoma caseyi</i>	Casey's june beetle	invertebrate
<i>Distocambarus carlsoni</i>	Mimic Crayfish	invertebrate

Latin Name	Common Name	Taxon
<i>Distocambarus devexus</i>	Broad River Burrowing Crayfish	invertebrate
<i>Distocambarus youngineri</i>	Newberry Burrowing Crayfish	invertebrate
<i>Doryopteris takeuchii</i>	Takeuch's Lip Fern	plant
<i>Driloleirus americanus</i>	Giant palouse earthworm	invertebrate
<i>Drosophila digressa</i>	Digressa picture-wing	invertebrate
<i>Echinomastus erectocentrus acunensis</i>	Acuna cactus	plant
<i>Elassoma alabamae</i>	Spring Pygmy Sunfish	fish
<i>Elassoma boehlkei</i>	Carolina pygmy sunfish	fish
<i>Eleutherodactylus juanariveroi</i>	Coqui Llanero	Amphibian
<i>Elimia acuta</i>	Acute Elimia	invertebrate
<i>Elimia alabamensis</i>	Mud Elimia	invertebrate
<i>Elimia ampla</i>	Ample Elimia	invertebrate
<i>Elimia annettae</i>	Lilyshoals Elimia	invertebrate
<i>Elimia arachnoidea</i>	Spider Elimia	invertebrate
<i>Elimia bellacrenata</i>	Princess Elimia	invertebrate
<i>Elimia bellula</i>	Walnut Elimia	invertebrate
<i>Elimia chiltonensis</i>	Prune Elimia	invertebrate
<i>Elimia cochliaris</i>	Cockle Elimia	invertebrate
<i>Elimia cylindracea</i>	Cylinder Elimia	invertebrate
<i>Elimia lachryma</i>	Nodulose Coosa River Snail	invertebrate
<i>Elimia melanoides</i>	Black Mudalia	invertebrate
<i>Elimia nassula</i>	Round-rib Elimia	invertebrate
<i>Elimia olivula</i>	Caper Elimia	invertebrate
<i>Elimia perstriata</i>	Engraved Elimia	invertebrate
<i>Elimia showalteri</i>	Compact Elimia	invertebrate
<i>Elimia teres</i>	Elegant Elimia	invertebrate
<i>Elimia vanuxemiana</i>	Cobble Elimia	invertebrate
<i>Elliptio ahenea</i>	Southern Lance	invertebrate
<i>Elliptio arca</i>	Alabama Spike	invertebrate
<i>Elliptio arctata</i>	Delicate Spike	invertebrate
<i>Elliptio fraterna</i>	Brother Spike	invertebrate
<i>Elliptio lanceolata</i>	Yellow Lance	invertebrate
<i>Elliptio monroensis</i>	St. John's Elephantear	invertebrate
<i>Elliptio purpurella</i>	Inflated Spike	invertebrate
<i>Elliptio spinosa</i>	Altamaha Spiny mussel	invertebrate
<i>Elytraria caroliniensis angustifolia</i>	Narrowleaf Carolina Scalystem	plant
<i>Emballonura semicaudata rotensis</i>	Mariana sheath-tailed bat	mammal
<i>Emballonura semicaudata semicaudata</i>	Sheath-tailed bat (American Samoa DPS)	mammal
<i>Encyclia cochleata triandra</i>	Clamshell Orchid	plant
<i>Epidendrum strobiliferum</i>	Big Cypress Epidendrum	plant
<i>Epioblasma triquetra</i>	Snuffbox	invertebrate
<i>Eremophila alpestris strigata</i>	Streaked horned lark	bird
<i>Erigeron lemmonii</i>	Lemmon's fleabane	plant

Latin Name	Common Name	Taxon
<i>Erimystax harrisi</i>	Ozark Chub	fish
<i>Eriocaulon koernickianum</i>	Small-headed Pipewort	plant
<i>Eriocaulon nigrobacteatum</i>	Black-bract Pipewort	plant
<i>Eriogonum codium</i>	Umtanum (Basalt) desert buckwheat	plant
<i>Eriogonum corymbosum nilesii</i>	Crispleaf Wild Buckwheat	plant
<i>Eriogonum diatomaceum</i>	Churchill Narrows Buckwheat	plant
<i>Eriogonum kelloggii</i>	Kellogg's Buckwheat	plant
<i>Etheostoma bellator</i>	Warrior Darter	fish
<i>Etheostoma brevirostrum</i>	Holiday Darter	fish
<i>Etheostoma cinereum</i>	Ashy Darter	fish
<i>Etheostoma cragini</i>	Arkansas Darter	fish
<i>Etheostoma forbesi</i>	Barrens Darter	fish
<i>Etheostoma maculatum</i>	Spotted Darter	fish
<i>Etheostoma microlepidum</i>	Smallscale Darter	fish
<i>Etheostoma moorei</i>	Yellowcheek Darter	fish
<i>Etheostoma osburni</i>	Candy Darter	fish
<i>Etheostoma pallidiorum</i>	Paleback Darter	fish
<i>Etheostoma phytophilum</i>	Rush Darter	fish
<i>Etheostoma pseudovulatum</i>	Egg-mimic Darter	fish
<i>Etheostoma sagitta spilatum</i>	Kentucky arrow darter	fish
<i>Etheostoma striatulum</i>	Striated Darter	fish
<i>Etheostoma susanae</i>	Cumberland Darter	fish
<i>Etheostoma tecumsehi</i>	Shawnee Darter	fish
<i>Etheostoma tippecanoe</i>	Tippecanoe Darter	fish
<i>Etheostoma trisella</i>	Trispot Darter	fish
<i>Etheostoma tuscumbia</i>	Tuscumbia Darter	fish
<i>Eua zebrina</i>	Tutuila tree snail	invertebrate
<i>Eumeces egregius egregius</i>	Florida Keys Mole Skink	reptile
<i>Eumops floridanus</i>	Florida bonneted bat	mammal
<i>Eupatorium paludicola</i>	Eupatorium paludicola	plant
<i>Euphydryas editha taylori</i>	Taylor's checkerspot butterfly	invertebrate
<i>Euphyes dukesii calhouni</i>	Dukes' Skipper	invertebrate
<i>Euphyes pilatka klotsi</i>	Palatka skipper butterfly	invertebrate
<i>Eurybia saxicastellii</i>	Rockcastle Wood-aster	plant
<i>Eurycea chamberlaini</i>	Chamberlain's Dwarf Salamander	Amphibian
<i>Eurycea chisholmensis</i>	Salado Salamander	Amphibian
<i>Eurycea naufragia</i>	Georgetown Salamander	Amphibian
<i>Eurycea tonkawae</i>	Jollyville Plateau Salamander	Amphibian
<i>Eurycea tynnerensis</i>	Oklahoma Salamander	Amphibian
<i>Eurycea wallacei</i>	Georgia blind salamander	Amphibian
<i>Eurycea waterlooensis</i>	Austin blind salamander	Amphibian
<i>Fallicambarus burrisi</i>	Burrowing Bog Crayfish	invertebrate
<i>Fallicambarus danielae</i>	Speckled Burrowing Crayfish	invertebrate

Latin Name	Common Name	Taxon
<i>Fallicambarus gilpini</i>	Jefferson County Crayfish	invertebrate
<i>Fallicambarus harpi</i>	Ouachita Burrowing Crayfish	invertebrate
<i>Fallicambarus hortonii</i>	Hatchie Burrowing Crayfish	invertebrate
<i>Fallicambarus petilicarpus</i>	Slenderwrist Burrowing Crayfish	invertebrate
<i>Fallicambarus strawni</i>	Saline Burrowing Crayfish	invertebrate
<i>Farancia erythrogramma seminola</i>	South Florida Rainbow Snake	reptile
<i>Festuca hawaiiensis</i>	Hawaiian Fescue	plant
<i>Festuca ligulata</i>	Guadalupe Fescue	plant
<i>Fimbristylis perpusilla</i>	Harper's Fimbristylis	plant
<i>Fissidens appalachensis</i>	Appalachian Fissidens Moss	plant
<i>Fissidens hallii</i>	Hall's Pocket Moss	plant
<i>Floridobia mica</i>	Ichetucknee Siltsnail	invertebrate
<i>Floridobia monroensis</i>	Enterprise Siltsnail	invertebrate
<i>Floridobia parva</i>	Pygmy Siltsnail	invertebrate
<i>Floridobia ponderosa</i>	Ponderous Siltsnail	invertebrate
<i>Floridobia wekiwae</i>	Wekiwa Siltsnail	invertebrate
<i>Fluminicola anserinus</i>	Goose Valley Pebblesnail	invertebrate
<i>Fluminicola multifarius</i>	Shasta Pebblesnail	invertebrate
<i>Fluminicola n. sp. 11</i>	Nerite Pebblesnail (=Fredenburg Pebblesnail)	invertebrate
<i>Fluminicola n. sp. 2</i>	Tall Pebblesnail	invertebrate
<i>Fluminicola n. sp. 3</i>	Diminutive Pebblesnail (=Klamath Rim Pebblesnail)	invertebrate
<i>Fluminicola potemicus</i>	Potem Pebblesnail	invertebrate
<i>Fluminicola seminalis</i>	Nugget Pebblesnail	invertebrate
<i>Fluminicola umbilicatus</i>	Hat Creek Pebblesnail	invertebrate
<i>Forestiera godfreyi</i>	Godfrey's Privet	plant
<i>Fundulus julisia</i>	Barrens Topminnow	fish
<i>Fusconaia barnesiana</i>	Tennessee Pigtoe	invertebrate
<i>Fusconaia burkei</i>	Tapered Pigtoe	invertebrate
<i>Fusconaia escambia</i>	Narrow Pigtoe	invertebrate
<i>Fusconaia masoni</i>	Atlantic Pigtoe	invertebrate
<i>Fusconaia rotulata</i>	Round Ebonyshell	invertebrate
<i>Fusconaia subrotunda</i>	Longsolid	invertebrate
<i>Gallicolumba stairi</i> American Samoa	Friendly ground dove (American Samoa DPS)	bird
<i>Gammarus hyalleloides</i>	Diminutive amphipod	invertebrate
<i>Gardenia remyi</i>	Remy's Gardenia	plant
<i>Gavia adamsii</i>	Yellow-billed Loon	bird
<i>Gelochelidon nilotica vanrossemi</i>	Van Rossem's gull-billed tern	bird
<i>Geranium hanaense</i>	Nohoanu	plant
<i>Geranium hillebrandii</i>	Nohoanu	plant
<i>Gila nigra</i>	Headwater chub	fish
<i>Gila robusta</i>	Roundtail chub	fish
<i>Glaucidium ridgwayi cactorum</i>	Cactus ferruginous pygmy owl	bird
<i>Glaucomys sabrinus californicus</i>	San Bernardino flying squirrel	mammal

Latin Name	Common Name	Taxon
<i>Glyphopsyche sequatchie</i>	Sequatchie Caddisfly	invertebrate
<i>Gomphus consanguis</i>	Cherokee Clubtail	invertebrate
<i>Gomphus sandrius</i>	Tennessee Clubtail	invertebrate
<i>Gomphus septima</i>	Septima's Clubtail	invertebrate
<i>Gomphus westfalli</i>	Westfall's Clubtail	invertebrate
<i>Gonocalyx concolor</i>	Island brittleleaf	plant
<i>Graptemys barbouri</i>	Barbour's Map Turtle	Amphibian
<i>Graptemys ernsti</i>	Escambia Map Turtle	Amphibian
<i>Graptemys gibbonsi</i>	Pascagoula Map Turtle	Amphibian
<i>Graptemys nigrinoda</i>	Black-knobbed Map Turtle	Amphibian
<i>Graptemys pulchra</i>	Alabama map turtle	Amphibian
<i>Graptopetalum bartramii</i>	Patagonia Mountain Leather-petal	plant
<i>Grus canadensis pratensis</i>	Florida Sandhill Crane	bird
<i>Gulo gulo luscus</i>	North American wolverine (Contiguous U.S. DPS)	mammal
<i>Gyrinophilus gulolineatus</i>	Berry Cave Salamander	Amphibian
<i>Gyrinophilus pallescens</i>	Tennessee Cave Salamander	Amphibian
<i>Gyrinophilus subterraneus</i>	West Virginia Spring Salamander	Amphibian
<i>Hamiota australis</i>	Southern Sandshell	invertebrate
<i>Harrisia aboriginum</i>	Aboriginal Prickly-apple	plant
<i>Hartwrightia floridana</i>	Florida Hartwrightia	plant
<i>Hazardia orcuttii</i>	Orcutt's Hazardia	invertebrate
<i>Hedyotis fluviatilis</i>	Water Bluet	plant
<i>Helianthus occidentalis plantagineus</i>	Shinner's Sunflower	plant
<i>Helianthus verticillatus</i>	Whorled sunflower	plant
<i>Hemphillia burringtoni</i>	Keeled Jumping-slug	invertebrate
<i>Hesperia dacotae</i>	Dakota skipper	invertebrate
<i>Heterelmis stephani</i>	Stephan's Heterelmis Riffle Beetle	invertebrate
<i>Hexastylis speciosa</i>	Harper's Heartleaf	plant
<i>Hibiscus dasycalyx</i>	Neches River Rosemallow	plant
<i>Hobbseus cristatus</i>	Crested Riverlet Crayfish	invertebrate
<i>Hobbseus orconectoides</i>	Oktibbeha Riverlet Crayfish	invertebrate
<i>Hobbseus petilus</i>	Tombigbee Riverlet Crayfish	invertebrate
<i>Hobbseus yalobushensis</i>	Yalobusha Riverlet Crayfish	invertebrate
<i>Hydroptila okaloosa</i>	Rogue Creek hydroptila caddisfly	invertebrate
<i>Hydroptila sarahae</i>	Sarah's Hydroptila Caddisfly	invertebrate
<i>Hydroptila sykora</i>	Sykora's Hydroptila Caddisfly	invertebrate
<i>Hyla wrightorum</i>	Arizona treefrog (Huachuca/Canelo DPS)	Amphibian
<i>Hymenocallis henryae</i>	Henry's Spider-lily	plant
<i>Hypericum edisonianum</i>	Edison's Ascyrum	plant
<i>Hypericum lissophloeus</i>	Smooth-barked St. John's-wort	plant
<i>Hypolimnas octocula mariannensis</i>	Mariana eight-spot butterfly	invertebrate
<i>Illicium parviflorum</i>	Yellow Anisetree	plant
<i>Io fluviatilis</i>	Spiny Riversnail	invertebrate

Latin Name	Common Name	Taxon
<i>lotichthys phlegethontis</i>	Least Chub	fish
<i>Ipomopsis polyantha</i>	Pagosa skyrocket	plant
<i>Isoetes hyemalis</i>	Winter Quillwort	plant
<i>Isoetes microvela</i>	Thin-wall Quillwort	plant
<i>Ivesia webberi</i>	Webber Ivesia	plant
<i>Joinvillea ascendens ascendens</i>	'Ohe	plant
<i>Juga n. sp. 2</i>	Basalt Juga	invertebrate
<i>Juga n. sp. 3</i>	Cinnamon Juga	invertebrate
<i>Kinosternon baurii</i> Lower Keys	Lower Florida Keys Striped mud turtle	Amphibian
<i>Kinosternon sonoriense longifemorale</i>	Sonoyta Mud Turtle	reptile
<i>Korthalsella degeneri</i>	Degener Korthalsella	plant
<i>Lagopus leucura altipetens</i>	Southern white-tailed ptarmigan	bird
<i>Lagopus leucura rainierensis</i>	Mt. Rainier white-tailed ptarmigan	bird
<i>Lampsilis fullerkati</i>	Waccamaw Fatmucket	invertebrate
<i>Lampsilis rafinesqueana</i>	Neosho Mucket	invertebrate
<i>Lasmigona holstonia</i>	Tennessee Heelsplitter	invertebrate
<i>Lasmigona subviridis</i>	Green Floater	invertebrate
<i>Laterallus jamaicensis jamaicensis</i>	Eastern Black Rail	bird
<i>Leavenworthia exigua laciniata</i>	Kentucky Gladecress	plant
<i>Leavenworthia texana</i>	Texas golden gladecress	plant
<i>Lepidostoma morsei</i>	Morse's Little Plain Brown Sedge	invertebrate
<i>Leptoxis arkansensis</i>	Arkansas Mudalia	invertebrate
<i>Leptoxis foremani</i>	Interrupted rocksnail	invertebrate
<i>Leptoxis picta</i>	Spotted Rocksnail	invertebrate
<i>Leptoxis virgata</i>	Smooth Mudalia	invertebrate
<i>Lesquerella globosa</i>	Lesquereux's Mustard	plant
<i>Leuctra szczytkoi</i>	Louisiana Needlefly	invertebrate
<i>Libellula jesseana</i>	Purple Skimmer	invertebrate
<i>Lilium iridollae</i>	Panhandle Lily	plant
<i>Lindera subcoriacea</i>	Bog Spicebush	plant
<i>Linum arenicola</i>	Sand Flax	plant
<i>Linum carteri carteri</i>	Carter's Small-flowered Flax	plant
<i>Linum westii</i>	West's Flax	plant
<i>Lirceus culveri</i>	Rye Cove Isopod	invertebrate
<i>Lithasia curta</i>	Knobby Rocksnail	invertebrate
<i>Lithasia duttoniana</i>	Helmet Rocksnail	invertebrate
<i>Lithobates okaloosae</i>	Florida Bog Frog	Amphibian
<i>Lithobates pipiens pop. 1</i>	Northern leopard frog (Western DPS)	Amphibian
<i>Lobelia boykinii</i>	Boykin's Lobelia	plant
<i>Ludwigia brevipes</i>	Long Beach Seedbox	plant
<i>Ludwigia ravenii</i>	Raven's Seedbox	plant
<i>Ludwigia spathulata</i>	Spathulate Seedbox	plant
<i>Lyogyrus n. sp. 1</i>	Columbia Dusksnail	invertebrate

Latin Name	Common Name	Taxon
<i>Lyogyrus n. sp. 3</i>	Canary Dusksnail	invertebrate
<i>Lythrum curtissii</i>	Curtiss' Loosestrife	plant
<i>Lythrum flagellare</i>	Lowland Loosestrife	plant
<i>Macbridea caroliniana</i>	Carolina Birds-in-a-nest	plant
<i>Macromia margarita</i>	Mountain River Cruiser	invertebrate
<i>Margaritifera marrianae</i>	Alabama Pearlshell	invertebrate
<i>Marshallia grandiflora</i>	Large-flowered Barbara's-buttons	plant
<i>Marstonia agarhecta</i>	Ocmulgee Marstonia	invertebrate
<i>Marstonia castor</i>	Beaverpond Marstonia	invertebrate
<i>Marstonia ozarkensis</i>	Ozark Pyrg	invertebrate
<i>Martes pennanti</i> Northern Rocky Mountain	Fisher (Northern Rocky Mountain DPS)	mammal
<i>Martes pennanti</i> pop. 1	Fisher (Pacific DPS)	mammal
<i>Medionidus conradicus</i>	Cumberland Moccasinshell	invertebrate
<i>Medionidus walkeri</i>	Suwannee Moccasinshell	invertebrate
<i>Megaceros aenigmaticus</i>	A hornwort	plant
<i>Megalagrion leptodemas</i>	Crimson Hawaiian damselfly	invertebrate
<i>Megalagrion nigrohamatum nigrolineatum</i>	Blackline Megalagrion Damselfly	invertebrate
<i>Megalagrion oceanicum</i>	Oceanic Megalagrion Damselfly	invertebrate
<i>Megalagrion xanthomelas</i>	Orange-black Megalagrion Damselfly	invertebrate
<i>Megaleuctra williamsae</i>	Smokies Needlefly	invertebrate
<i>Melicope christophersenii</i>	Christophersen's pelea	plant
<i>Melicope hiiakae</i>	Koolau Range Melicope	plant
<i>Melicope makahae</i>	Makaha Valley Melicope	plant
<i>Metabetaeus lohena</i>	Anchialine pool shrimp 4	invertebrate
<i>Microlepia strigosa mauiensis</i>	Wawae 'iole	plant
<i>Mimulus fremontii vandenbergensis</i>	Vandenberg monkeyflower	plant
<i>Minuartia godfreyi</i>	Godfrey's Stitchwort	plant
<i>Monadenia chaceana</i>	Siskiyou Shoulderband	invertebrate
<i>Monadenia fidelis minor</i>	Dalles Sideband	invertebrate
<i>Monadenia troglodytes troglodytes</i>	Shasta Sideband	invertebrate
<i>Monadenia troglodytes wintu</i>	Wintu Sideband	invertebrate
<i>Moxostoma robustum</i>	Robust Redhorse	fish
<i>Moxostoma sp. 2</i>	Sicklefin Redhorse	fish
<i>Myotis leibii</i>	Eastern small-footed bat	mammal
<i>Myotis septentrionalis</i>	Northern myotis	mammal
<i>Myrsine fosbergii</i>	Koolau Range Colicwood	plant
<i>Myrsine vaccinioides</i>	Violet Lake Colicwood	plant
<i>Najas filifolia</i>	Narrowleaf Naiad	plant
<i>Narthecium americanum</i>	Bog Asphodel	plant
<i>Necturus alabamensis</i>	Black Warrior Waterdog	Amphibian
<i>Necturus lewisi</i>	Neuse River waterdog	Amphibian
<i>Newcombia cumingi</i>	Newcomb's Tree Snail	invertebrate
<i>Nothoecstrum latifolium</i>	'Aiea	plant

Latin Name	Common Name	Taxon
<i>Notophthalmus perstriatus</i>	Striped Newt	Amphibian
<i>Notropis ariommus</i>	Popeye Shiner	fish
<i>Notropis buccula</i>	Smalleye Shiner	fish
<i>Notropis oxyrhynchus</i>	Sharpnose Shiner	fish
<i>Notropis ozarcanus</i>	Ozark Shiner	fish
<i>Notropis perpallidus</i>	Peppered Shiner	fish
<i>Notropis suttkusi</i>	Rocky Shiner	fish
<i>Noturus crypticus</i>	Chucky Madtom	fish
<i>Noturus fasciatus</i>	Saddled Madtom	fish
<i>Noturus furiosus</i>	Carolina Madtom	fish
<i>Noturus gilberti</i>	Orangefin Madtom	fish
<i>Noturus gladiator</i>	Piebald Madtom	fish
<i>Noturus lachneri</i>	Ouachita Madtom	fish
<i>Noturus munitus</i>	Frecklebelly Madtom	fish
<i>Noturus taylori</i>	Caddo Madtom	fish
<i>Nuphar lutea sagittifolia</i>	Cape Fear Spatterdock	plant
<i>Nuphar lutea ulvacea</i>	West Florida Cow-lily	plant
<i>Nysius weikiuicola</i>	Wekiu Bug	invertebrate
<i>Nyssa ursina</i>	Bear Tupelo	plant
<i>Obovaria subrotunda</i>	Round Hickorynut	invertebrate
<i>Obovaria unicolor</i>	Alabama Hickorynut	invertebrate
<i>Oceanodroma castro</i>	Band-rumped storm-petrel	bird
<i>Oceanodroma homochroa</i>	Ashy storm-petrel	bird
<i>Ochrosia haleakalae</i>	Holei	plant
<i>Odobenus rosmarus</i>	Walrus	mammal
<i>Oecetis parva</i>	Little Oecetis Longhorn Caddisfly	invertebrate
<i>Oncidium undulatum</i>	Cape Sable orchid	plant
<i>Oncorhynchus clarki virginalis</i>	Rio Grande cutthroat trout	fish
<i>Oncorhynchus mykiss aguabonita</i>	California Golden Trout	fish
<i>Oncorhynchus nerka Lake Sammamish</i>	Sammamish Lake kokanee	fish
<i>Ophiogomphus australis</i>	Southern Snaketail	invertebrate
<i>Ophiogomphus edmundo</i>	Edmund's Snaketail	invertebrate
<i>Ophiogomphus incurvatus</i>	Appalachian Snaketail	invertebrate
<i>Opuntia corallicola</i>	Florida Semaphore Cactus	plant
<i>Orconectes blacki</i>	Calcasieu Crayfish	invertebrate
<i>Orconectes burri</i>	Blood River Crayfish	invertebrate
<i>Orconectes eupunctus</i>	Coldwater Crayfish	invertebrate
<i>Orconectes hartfieldi</i>	Yazoo Crayfish	invertebrate
<i>Orconectes incomptus</i>	Tennessee Cave Crayfish	invertebrate
<i>Orconectes jonesi</i>	Sucarnoochee River Crayfish	invertebrate
<i>Orconectes maletae</i>	Kisatchie Painted Crayfish	invertebrate
<i>Orconectes marchandi</i>	Mammoth Spring Crayfish	invertebrate
<i>Orconectes packardii</i>	Appalachian Cave Crayfish	invertebrate

Latin Name	Common Name	Taxon
<i>Orconectes sheltae</i>	Shelta Cave Crayfish	invertebrate
<i>Orconectes virginianus</i>	Chowanoke Crayfish	invertebrate
<i>Orconectes wrighti</i>	Hardin Crayfish	invertebrate
<i>Oreohelix n. sp. 1</i>	Chelan Mountainsnail	invertebrate
<i>Oryzomys palustris pop. 1</i>	Pine Island Oryzomys	mammal
<i>Oryzomys palustris pop. 2</i>	Sanibel Island Oryzomys	mammal
<i>Ostodes strigatus</i>	Sisi	invertebrate
<i>Oxyethira setosa</i>	Setose Cream and Brown Mottled Microcaddisfly	invertebrate
<i>Palaemonella burnsi</i>	Anchialine pool shrimp 3	invertebrate
<i>Partula gibba</i>	Humped tree snail	invertebrate
<i>Partula langfordi</i>	Langford's tree snail	invertebrate
<i>Partula radiolata</i>	Guam tree snail	invertebrate
<i>Partulina semicarinata</i>	Lanai Tree Snail	invertebrate
<i>Partulina variabilis</i>	Lanai Tree Snail	invertebrate
<i>Pectis imberbis</i>	Beardless Chinch Weed	plant
<i>Pediocactus peeblesianus fickeiseniae</i>	Fickeisen's Hedgehog Cactus	plant
<i>Penstemon debilis</i>	Parachute beardtongue	plant
<i>Penstemon scariosus albifluvis</i>	White River Beardtongue	plant
<i>Peperomia subpetiolata</i>	Waikamoi Peperomia	plant
<i>Percina aurora</i>	Pearl Darter	fish
<i>Percina bimaculata</i>	Chesapeake Logperch	fish
<i>Percina brevicauda</i>	Coal Darter	fish
<i>Percina crypta</i>	Halloween Darter	fish
<i>Percina cymatotaenia</i>	Bluestripe Darter	fish
<i>Percina kusha</i>	Bridled Darter	fish
<i>Percina macrocephala</i>	Longhead Darter	fish
<i>Percina nasuta</i>	Longnose Darter	fish
<i>Percina siphi</i>	Bankhead Darter	fish
<i>Percina williamsi</i>	Sickle Darter	fish
<i>Phacelia scopulina submutica</i>	DeBeque Phacelia	plant
<i>Phacelia stellaris</i>	Brand's Phacelia	plant
<i>Phaeophyscia leana</i>	Lea's Bog Lichen	plant
<i>Phlegmariurus stemmermanniae</i>	Wawae 'iole	plant
<i>Phoebastria nigripes</i>	Black-footed Albatross	bird
<i>Phyllostegia bracteata</i>	Bracted Phyllostegia	plant
<i>Phyllostegia floribunda</i>	Many-flowered phyllostegia	plant
<i>Physaria tuplashensis</i>	White bluffs bladderpod	plant
<i>Physostegia correllii</i>	Correll's False Dragon-head	plant
<i>Pituophis melanoleucus lodingi</i>	Black Pinesnake	reptile
<i>Pituophis ruthveni</i>	Louisiana pinesnake	reptile
<i>Plagiochila caduciloba</i>	Gorge Leafy Liverwort	plant
<i>Plagiochila sharpii sharpii</i>	Sharp's Leafy Liverwort	plant
<i>Planorbella magnifica</i>	Magnificent Rams-horn	invertebrate

Latin Name	Common Name	Taxon
<i>Platanthera integrilabia</i>	White fringeless orchid	plant
<i>Platydesma cornuta cornuta</i>	Oahu Pilo Kea	plant
<i>Platydesma cornuta decurrens</i>	Oahu Pilo Kea	plant
<i>Platydesma remyi</i>	Remy pilokea	plant
<i>Plebejus shasta charlestonensis</i>	Mt. Charleston blue	invertebrate
<i>Pleomele fernaldii</i>	Lanai Pleomele	plant
<i>Pleomele forbesii</i>	Forbe's Dracaena	plant
<i>Plethobasus cyphus</i>	Sheepnose	invertebrate
<i>Plethodon ainsworthi</i>	Catahoula salamander	Amphibian
<i>Plethodon neomexicanus</i>	Jemez Mountains salamander	Amphibian
<i>Pleurobema atearni</i>	Canoe Creek Pigtoe	invertebrate
<i>Pleurobema hanleyianum</i>	Georgia pigtoe	invertebrate
<i>Pleurobema oviforme</i>	Tennessee Clubshell	invertebrate
<i>Pleurobema rubellum</i>	Warrior pigtoe	invertebrate
<i>Pleurobema rubrum</i>	Pyramid Pigtoe	invertebrate
<i>Pleurobema strodeanum</i>	Fuzzy Pigtoe	invertebrate
<i>Pleurocera corpulenta</i>	Corpulent Hornsnail	invertebrate
<i>Pleurocera curta</i>	Shortspire Hornsnail	invertebrate
<i>Pleurocera foremani</i>	Rough hornsnail	invertebrate
<i>Pleurocera pyrenella</i>	Skirted Hornsnail	invertebrate
<i>Pleuroaia dolabelloides</i>	Slabside Pearlymussel	invertebrate
<i>Polites mardon</i>	Mardon skipper	invertebrate
<i>Polycentropus floridensis</i>	Florida Brown Checkered Summer Sedge	invertebrate
<i>Popenaias popeii</i>	Texas Hornshell	invertebrate
<i>Porzana tabuensis</i>	Spotless crane	bird
<i>Potamogeton floridanus</i>	Florida Pondweed	plant
<i>Potamogeton tennesseensis</i>	Tennessee Pondweed	plant
<i>Potentilla basaltica</i>	Soldier Meadows Cinquefoil	plant
<i>Pristiloma arcticum crateris</i>	Crater Lake Tightcoil	invertebrate
<i>Problema bulenta</i>	Rare Skipper	invertebrate
<i>Procambarus acherontis</i>	Orlando Cave Crayfish	invertebrate
<i>Procambarus apalachicola</i>	Coastal Flatwoods Crayfish	invertebrate
<i>Procambarus attiguus</i>	Silver Glen Springs Crayfish	invertebrate
<i>Procambarus barbigier</i>	Jackson Prairie Crayfish	invertebrate
<i>Procambarus cometes</i>	Mississippi Flatwoods Crayfish	invertebrate
<i>Procambarus delicatus</i>	Bigcheek Cave Crayfish	invertebrate
<i>Procambarus econfinae</i>	Panama City Crayfish	invertebrate
<i>Procambarus erythrops</i>	Santa Fe Cave Crayfish	invertebrate
<i>Procambarus fitzpatricki</i>	Spinytail Crayfish	invertebrate
<i>Procambarus franzi</i>	Orange Lake Cave Crayfish	invertebrate
<i>Procambarus horsti</i>	Big Blue Springs Crayfish	invertebrate
<i>Procambarus lagniappe</i>	Lagniappe Crayfish	invertebrate
<i>Procambarus leitheuseri</i>	Coastal Lowland Cave Crayfish	invertebrate

Latin Name	Common Name	Taxon
<i>Procambarus lucifugus</i>	Florida Cave Crayfish	invertebrate
<i>Procambarus lucifugus alachua</i>	Alachua Light Fleeing Cave Crayfish	invertebrate
<i>Procambarus lucifugus lucifugus</i>	Florida Cave Crayfish	invertebrate
<i>Procambarus lylei</i>	Shutispear Crayfish	invertebrate
<i>Procambarus milleri</i>	Miami Cave Crayfish	invertebrate
<i>Procambarus morrissi</i>	Putnum County Cave Crayfish	invertebrate
<i>Procambarus orcinus</i>	Woodville Karst Cave Crayfish	invertebrate
<i>Procambarus pallidus</i>	Pallid Cave Crayfish	invertebrate
<i>Procambarus pictus</i>	Black Creek Crayfish	invertebrate
<i>Procambarus pogum</i>	Bearded Red Crayfish	invertebrate
<i>Procambarus regalis</i>	Regal Burrowing Crayfish	invertebrate
<i>Procambarus reimeri</i>	Irons Fork Burrowing Crayfish	invertebrate
<i>Procaris hawaiiiana</i>	Anchialine pool shrimp 2	invertebrate
<i>Pseudanophthalmus avernus</i>	Avernus Cave Beetle	invertebrate
<i>Pseudanophthalmus caecus</i>	Clifton Cave Beetle	invertebrate
<i>Pseudanophthalmus colemanensis</i>	Coleman Cave Beetle	invertebrate
<i>Pseudanophthalmus cordicollis</i>	Little Kennedy Cave Beetle	invertebrate
<i>Pseudanophthalmus egberti</i>	New River Valley Cave Beetle	invertebrate
<i>Pseudanophthalmus fowlerae</i>	Fowler's Cave Beetle	invertebrate
<i>Pseudanophthalmus frigidus</i>	Icebox Cave Beetle	invertebrate
<i>Pseudanophthalmus hirsutus</i>	Cumberland Gap Cave Beetle	invertebrate
<i>Pseudanophthalmus hubbardi</i>	Hubbard's Cave Beetle	invertebrate
<i>Pseudanophthalmus hubrichti</i>	Hubricht's Cave Beetle	invertebrate
<i>Pseudanophthalmus inquisitor</i>	Inquirer Cave Beetle	invertebrate
<i>Pseudanophthalmus insularis</i>	Baker Station Cave Beetle	invertebrate
<i>Pseudanophthalmus intersectus</i>	Crossroads Cave Beetle	invertebrate
<i>Pseudanophthalmus limicola</i>	Maddens Cave Beetle	invertebrate
<i>Pseudanophthalmus montanus</i>	Dry Fork Valley Cave Beetle	invertebrate
<i>Pseudanophthalmus parvus</i>	Tatum Cave Beetle	invertebrate
<i>Pseudanophthalmus paulus</i>	Nobletts Cave Beetle	invertebrate
<i>Pseudanophthalmus pontis</i>	Natural Bridge Cave Beetle	invertebrate
<i>Pseudanophthalmus potomaca</i>	South Branch Valley Cave Beetle	invertebrate
<i>Pseudanophthalmus praetermissus</i>	Overlooked Cave Beetle	invertebrate
<i>Pseudanophthalmus sanctipauli</i>	Saint Paul Cave Beetle	invertebrate
<i>Pseudanophthalmus sericus</i>	Silken Cave Beetle	invertebrate
<i>Pseudanophthalmus thomasi</i>	Thomas' Cave Beetle	invertebrate
<i>Pseudanophthalmus tiresias</i>	Indian Cave Point Cave Beetle	invertebrate
<i>Pseudanophthalmus troglodytes</i>	Louisville Cave Beetle	invertebrate
<i>Pseudanophthalmus virginicus</i>	Maiden Spring Cave Beetle	invertebrate
<i>Pseudemys nelsoni</i> pop. 1	Florida red-bellied turtle (Florida Panhandle DPS)	Amphibian
<i>Pseudemys rubriventris</i>	Northern red-bellied cooter	Amphibian
<i>Pseudobranchius striatus lustricolus</i>	Gulf Hammock Dwarf Siren	Amphibian
<i>Pseudognaphalium sandwicensium molokaiense</i>	`Ena`Ena	plant

Latin Name	Common Name	Taxon
<i>Pseudotryonia adamantina</i>	Diamond Tryonia	invertebrate
<i>Psychotria hexandra oahuensis</i>	Oahu wild coffee	plant
<i>Pteralyxia macrocarpa</i>	Kaulu	plant
<i>Pteronotropis euryzonus</i>	Broadstripe Shiner	fish
<i>Pteronotropis hubbsi</i>	Bluehead Shiner	fish
<i>Ptilimnium ahlesii</i>	Carolina Bishopweed	plant
<i>Ptychobranchius jonesi</i>	Southern Kidneyshell	invertebrate
<i>Ptychobranchius subtentum</i>	Fluted Kidneyshell	invertebrate
<i>Pyganodon gibbosa</i>	Inflated Floater	invertebrate
<i>Pyrgulopsis aloba</i>	Duckwater Pyrg	invertebrate
<i>Pyrgulopsis anatina</i>	Southern Duckwater Pyrg	invertebrate
<i>Pyrgulopsis anguina</i>	Longitudinal gland pyrg	invertebrate
<i>Pyrgulopsis avernalis</i>	Moapa Pebblesnail	invertebrate
<i>Pyrgulopsis bernardina</i>	San Bernardino springsnail	invertebrate
<i>Pyrgulopsis breviloba</i>	Flat Pyrg	invertebrate
<i>Pyrgulopsis carinifera</i>	Moapa Valley pyrg	invertebrate
<i>Pyrgulopsis chupaderae</i>	Chupadera Springsnail	invertebrate
<i>Pyrgulopsis coloradensis</i>	Blue Point Pyrg	invertebrate
<i>Pyrgulopsis crystalis</i>	Crystal Springsnail	invertebrate
<i>Pyrgulopsis deaconi</i>	Spring Mountains Pyrg	invertebrate
<i>Pyrgulopsis erythropoma</i>	Ash Meadows Pebblesnail	invertebrate
<i>Pyrgulopsis fairbanksensis</i>	Fairbanks Springsnail	invertebrate
<i>Pyrgulopsis fausta</i>	Corn Creek Pyrg	invertebrate
<i>Pyrgulopsis gilae</i>	Gila Springsnail	invertebrate
<i>Pyrgulopsis gracilis</i>	Emigrant pyrg	invertebrate
<i>Pyrgulopsis hamlinensis</i>	Hamlin Valley pyrg	invertebrate
<i>Pyrgulopsis hubbsi</i>	Hubbs Pyrg	invertebrate
<i>Pyrgulopsis isolata</i>	Elongate-gland Springsnail	invertebrate
<i>Pyrgulopsis landyei</i>	Landyes Pyrg	invertebrate
<i>Pyrgulopsis lata</i>	Butterfield Pyrg	invertebrate
<i>Pyrgulopsis lockensis</i>	Lockes Pyrg	invertebrate
<i>Pyrgulopsis marcida</i>	Hardy Pyrg	invertebrate
<i>Pyrgulopsis merriami</i>	Pahranagat Pebblesnail	invertebrate
<i>Pyrgulopsis montana</i>	Camp Valley pyrg	invertebrate
<i>Pyrgulopsis morrisoni</i>	Page Springsnail	invertebrate
<i>Pyrgulopsis nanus</i>	Distal-gland Springsnail	invertebrate
<i>Pyrgulopsis neritella</i>	Neritiform Steptoe Ranch Pyrg	invertebrate
<i>Pyrgulopsis notidicola</i>	Elongate Mud Meadows Pyrg	invertebrate
<i>Pyrgulopsis orbiculata</i>	Sub-globose Steptoe Ranch Pyrg	invertebrate
<i>Pyrgulopsis papillata</i>	Big Warm Spring Pyrg	invertebrate
<i>Pyrgulopsis peculiaris</i>	Bifid Duct Pyrg	invertebrate
<i>Pyrgulopsis pisteri</i>	Median-gland Springsnail	invertebrate
<i>Pyrgulopsis planulata</i>	Flat-topped Steptoe Pyrg	invertebrate

Latin Name	Common Name	Taxon
<i>Pyrgulopsis sathos</i>	White River Valley Pyrg	invertebrate
<i>Pyrgulopsis saxatilis</i>	Sub-globose snake pyrg	invertebrate
<i>Pyrgulopsis serrata</i>	Northern Steptoe Pyrg	invertebrate
<i>Pyrgulopsis sterilis</i>	Sterile Basin Pyrg	invertebrate
<i>Pyrgulopsis sublata</i>	Lake Valley Pyrg	invertebrate
<i>Pyrgulopsis sulcata</i>	Southern Steptoe Pyrg	invertebrate
<i>Pyrgulopsis thermalis</i>	New Mexico Hot Springsnail	invertebrate
<i>Pyrgulopsis thompsoni</i>	Huachuca Springsnail	invertebrate
<i>Pyrgulopsis trivialis</i>	Three Forks springsnail	invertebrate
<i>Pyrgulopsis turbatrix</i>	Southeast Nevada Pyrg	invertebrate
<i>Pyrgulopsis villacampae</i>	Duckwater Warm springs pyrg	invertebrate
<i>Quadrula asperata archeri</i>	Tallapoosa Orb	invertebrate
<i>Quadrula cylindrica cylindrica</i>	Rabbitsfoot	invertebrate
<i>Rana luteiventris</i> Great Basin	Columbia spotted frog, Great Basin population	Amphibian
<i>Rana muscosa</i> Sierra Nevada	Mountain yellow-legged frog	Amphibian
<i>Rana onca</i>	Relict Leopard Frog	Amphibian
<i>Rana pretiosa</i>	Oregon spotted frog	Amphibian
<i>Ranunculus hawaiiensis</i>	Large-flower Native Buttercup	plant
<i>Ranunculus mauianensis</i>	Makou	plant
<i>Remenus kirchneri</i>	Blueridge Springfly	invertebrate
<i>Rhexia parviflora</i>	Small-flower Meadow-beauty	plant
<i>Rhexia salicifolia</i>	Panhandle Meadow-beauty	plant
<i>Rhodacme elatior</i>	Domed Ancyliid	invertebrate
<i>Rhynchospora crinipes</i>	Hairy-peduncled Beakrush	plant
<i>Rhynchospora thornei</i>	Thorne's Beakrush	plant
<i>Rorippa subumbellata</i>	Tahoe Yellowcress	plant
<i>Rudbeckia auriculata</i>	Eared Coneflower	plant
<i>Rudbeckia heliopsisidis</i>	Sun-facing Coneflower	plant
<i>Salix floridana</i>	Florida Willow	plant
<i>Samoana fragilis</i>	Fragile tree snail	invertebrate
<i>Sarracenia purpurea montana</i>	Purple Pitcherplant	plant
<i>Sarracenia rubra gulfensis</i>	Gulf Sweet Pitcherplant	plant
<i>Sarracenia rubra wherryi</i>	Wherry's Sweet Pitcherplant	plant
<i>Sceloporus arenicolus</i>	Dunes sagebrush lizard	reptile
<i>Schiedea pubescens</i>	Hairy Schiedea	plant
<i>Schiedea salicaria</i>	Ma'oli'oli	plant
<i>Schoenoplectus hallii</i>	Hall's Bulrush	plant
<i>Scutellaria ocmulgee</i>	Ocmulgee Skullcap	plant
<i>Sedum eastwoodiae</i>	Red Mountain Stonecrop	plant
<i>Sicyos macrophyllus</i>	Largeleaf Bur-cucumber	plant
<i>Sideroxylon reclinatum austrofloridense</i>	Everglades Bully	plant
<i>Sideroxylon thornei</i>	Swamp Buckthorn	plant
<i>Sigmodon hispidus insulicola</i>	Insular Cotton Rat	mammal

Latin Name	Common Name	Taxon
<i>Simpsonaias ambigua</i>	Salamander mussel	invertebrate
<i>Sistrurus catenatus catenatus</i>	Eastern massasauga rattlesnake	reptile
<i>Solanum nelsonii</i>	Nelson's Horse-nettle	plant
<i>Solidago arenicola</i>	Southern Racemose Goldenrod	plant
<i>Solidago plumosa</i>	Yadkin River Goldenrod	plant
<i>Somatochlora calverti</i>	Calvert's Emerald	invertebrate
<i>Somatochlora margarita</i>	Texas Emerald	invertebrate
<i>Somatochlora ozarkensis</i>	Ozark Emerald	invertebrate
<i>Somatogyris alcoviensis</i>	Reverse Pebblesnail	invertebrate
<i>Sonorella magdalenensis</i>	Sonoran talussnail	invertebrate
<i>Sonorella rosemontensis</i>	Rosemont talussnail	invertebrate
<i>Spermophilus brunneus endemicus</i>	Southern Idaho ground squirrel	mammal
<i>Spermophilus washingtoni</i>	Washington ground squirrel	mammal
<i>Sphaeralcea gieriichii</i>	Gierisch's Globe-Mallow	plant
<i>Sporobolus teretifolius</i>	Wireleaf Dropseed	plant
<i>Stellaria fontinalis</i>	Water Stitchwort	plant
<i>Stenogyne cranwelliae</i>	Kohala Mountain stenogyne	plant
<i>Strymon acis bartrami</i>	Bartram's Hairstreak	invertebrate
<i>Stygobromus cooperi</i>	Cooper's Cave Amphipod	invertebrate
<i>Stygobromus indentatus</i>	Tidewater Amphipod	invertebrate
<i>Stygobromus kenki</i>	Rock Creek Groundwater Amphipod	invertebrate
<i>Stygobromus morrisoni</i>	Morrison's Cave Amphipod	invertebrate
<i>Stygobromus parvus</i>	Minute Cave Amphipod	invertebrate
<i>Stylurus potulentus</i>	Yellow-sided Clubtail	invertebrate
<i>Sylvilagus transitionalis</i>	New England cottontail rabbit	mammal
<i>Symphyotrichum georgianum</i>	Georgia aster	plant
<i>Symphyotrichum puniceum scabriceale</i>	Rough-stemmed Aster	plant
<i>Synthliboramphus hypoleucus</i>	Xantus's murrelet	bird
<i>Tallaperla lobata</i>	Lobed Roachfly	invertebrate
<i>Thalictrum debile</i>	Southern Meadowrue	plant
<i>Thamnophis eques</i>	Mexican gartersnake	reptile
<i>Thamnophis sauritus pop. 1</i>	Eastern ribbonsnake (Lower Florida Keys DPS)	reptile
<i>Thoburnia atripinnis</i>	Blackfin Sucker	fish
<i>Thomomys mazama couchi</i>	Shelton pocket gopher	mammal
<i>Thomomys mazama douglasii</i>	Brush Prairie pocket gopher	mammal
<i>Thomomys mazama glacialis</i>	Roy Prairie Pocket Gopher	mammal
<i>Thomomys mazama louiei</i>	Cathlamet pocket g	mammal
<i>Thomomys mazama melanops</i>	Olympic pocket gopher	mammal
<i>Thomomys mazama pugetensis</i>	Olympia pocket gopher	mammal
<i>Thomomys mazama tacomensis</i>	Tacoma pocket gopher	mammal
<i>Thomomys mazama tumuli</i>	Tenino pocket gopher	mammal
<i>Thomomys mazama yelmensis</i>	Yelm Pocket Gopher	mammal
<i>Thymallus arcticus pop. 2</i>	Arctic Grayling - Upper Missouri River Fluvial	fish

Latin Name	Common Name	Taxon
<i>Toxolasma lividus</i>	Purple Lilliput	invertebrate
<i>Toxolasma pullus</i>	Savannah Lilliput	invertebrate
<i>Trienodes tridentatus</i>	Three-tooth Trienodes Caddisfly	invertebrate
<i>Trichomanes punctatum floridanum</i>	Dotted Brittle Fern	plant
<i>Trillium texanum</i>	Texas Trillium	plant
<i>Trilobopsis roperi</i>	Shasta Chaparral	invertebrate
<i>Trilobopsis tehamana</i>	Tehama Chaparral	invertebrate
<i>Troglocambarus maclanei</i>	North Florida Spider Cave Crayfish	invertebrate
<i>Tryonia angulata</i>	Sportingoods Tryonia	invertebrate
<i>Tryonia cheatumi</i>	Phantom Tryonia	invertebrate
<i>Tryonia circumstriata</i>	Gonzales springsnail	invertebrate
<i>Tryonia clathrata</i>	Grated Tryonia	invertebrate
<i>Tryonia elata</i>	Point of Rocks Tryonia	invertebrate
<i>Tryonia ericae</i>	Minute Tryonia	invertebrate
<i>Tryonia variegata</i>	Amargosa Tryonia	invertebrate
<i>Tsuga caroliniana</i>	Carolina Hemlock	plant
<i>Tympanuchus pallidicinctus</i>	Lesser prairie-chicken	bird
<i>Uma scoparia Amargosa River</i>	Mojave fringe-toed lizard (Amargosa River DPS)	reptile
<i>Urspeleperes brucei</i>	Patch-nosed salamander	Amphibian
<i>Vagrans egestina</i>	Mariana wandering butterfly	invertebrate
<i>Vertigo n. sp. 1</i>	Hoko Vertigo	invertebrate
<i>Vespericola pressleyi</i>	Big Bar Hesperian	invertebrate
<i>Vespericola shasta</i>	Shasta Hesperian	invertebrate
<i>Vestiaria coccinea</i>	'I'iwi (Scarlet Hawaiian honeycreeper)	bird
<i>Vetericaris chaceorum</i>	Anchialine pool shrimp 1	invertebrate
<i>Vicia ocalensis</i>	Ocala Vetch	plant
<i>Villosa arkansasensis</i>	Ouachita Creekshell	invertebrate
<i>Villosa choctawensis</i>	Choctaw Bean	invertebrate
<i>Villosa fabalis</i>	Rayed bean	invertebrate
<i>Villosa nebulosa</i>	Alabama Rainbow	invertebrate
<i>Villosa ortmanni</i>	Kentucky Creekshell	invertebrate
<i>Villosa vanuxemensis umbrans</i>	Coosa Creekshell	invertebrate
<i>Vorticifex n. sp. 1</i>	Knobby Rams-horn	invertebrate
<i>Waldsteinia lobata</i>	Lobed Barren-strawberry	plant
<i>Xerospermophilus mohavensis</i>	Mohave ground squirrel	mammal
<i>Xyris longisepala</i>	Kral's Yellow-eyed-grass	plant
<i>Zanthoxylum oahuense</i>	Oahu Prickly-ash	plant
<i>Zapus hudsonius luteus</i>	New Mexican jumping mouse	mammal

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.					
1. REPORT DATE (DD-MM-YYYY) 15-03-2016		2. REPORT TYPE Final		3. DATES COVERED (From - To)	
4. TITLE AND SUBTITLE Evaluation of 757 Species Under U.S. Endangered Species Act Review on U.S. Department of Defense Lands and their Potential Impact on Army Training				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT	
6. AUTHOR(S) Jinelle H. Sperry, Wade A. Wall, and Matthew G. Hohmann				5d. PROJECT NUMBER 622720A896	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER DD3C7B	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Engineer Research and Development Center (ERDC) Construction Engineering Research Laboratory (CERL) PO Box 9005, Champaign, IL 61826-9005				8. PERFORMING ORGANIZATION REPORT NUMBER ERDC/CERL TR-16-3	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Office of the Assistant Chief of Staff for Installation Management 600 Army Pentagon Washington, DC 20310				10. SPONSOR/MONITOR'S ACRONYM(S) OACSIM-ISE	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT Most land bases where U.S. Army installations reside are ecologically significant and provide refuge for a large number of the nation's threatened and endangered plants and animals. Balancing threatened and endangered species (TES) management with training requirements is an increasingly difficult responsibility as the number of federally listed species grows. This work developed methods for determining impacts of potential future TES listings to Army capabilities and conducted a national level assessment of the risk to Army training by species currently petitioned or under review for federal listing. Of the 757 species reviewed, 233 were found to have the potential to be found on or near Army and Army National Guard installations. Species that were found on a large number of installations, such as the Sprague's pipit (<i>Anthus spragueii</i>), are those likely to have the most impact on training. Similarly, installations at greatest risk were those that housed a large number of species. Because of the large number of southeastern U.S. petitioned species, the majority of installations identified as at greatest risk are installations found in that region. Proactive management of these species, including leveraging partner opportunities, has the potential to mitigate negative impacts of Endangered Species Act (ESA) listing.					
15. SUBJECT TERMS U.S. Endangered Species Act (ESA), threatened and endangered species (TES), Army Training, military installations					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT SAR	18. NUMBER OF PAGES 62	19a. NAME OF RESPONSIBLE PERSON
a. REPORT Unclassified	b. ABSTRACT Unclassified	c. THIS PAGE Unclassified			19b. TELEPHONE NUMBER (include area code)